Fischer Porter Upgrade
Technical Manual

Version 2.2

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COASTAL ENVIRONMENTAL SYSTEMS

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1. SYSTEM DESCRIPTION AND THEORY OF OPERATION

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This section describes the Fischer Porter (FP) Upgrade and theory of operation for each part of the system. This section should be read as an aid to maintenance and troubleshooting.

1.1 SYSTEM COMPONENTS

The purpose of the FP Upgrade is to provide a replacement recording system that will sense, convert and record precipitation data at 15 minute intervals, maintain a non-volatile record of the data sufficient to support monthly data retrieval, allow operator notations to indicate changes due to emptying the gauge or other maintenance, provide a non-volatile removable electronic memory transport module, display the amount of captured precipitation in inches of water, and be powered by a 12 volt battery with solar recharging. The FP Upgrade comprises a Gauge Modification Assembly (GMA) and may include a Data and Communications (DCOM) unit and/or Extreme Environment Enclosure (EEv). The FP Upgrade also supports shaft encoder and thermistor measurements.

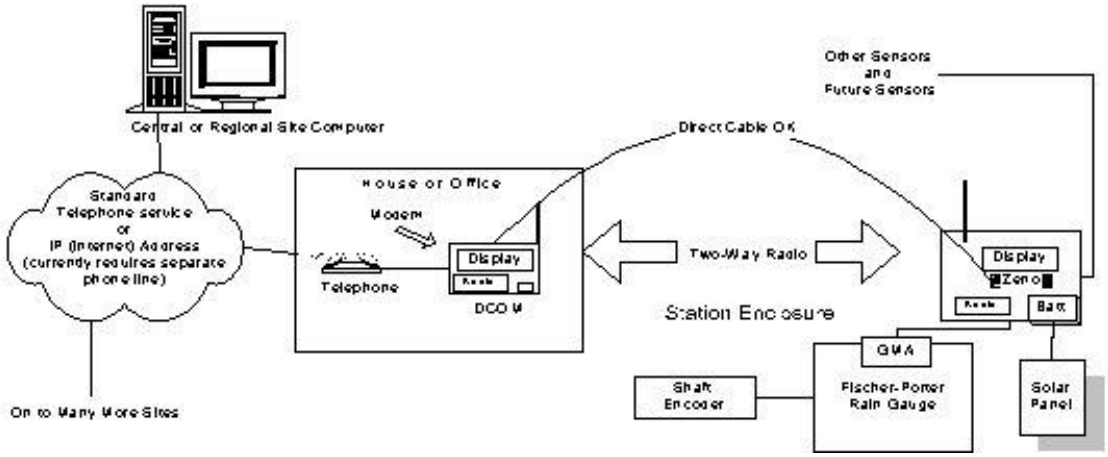

Figure 1-1. System Diagram for the GMA with DCOM

1.1.1 GMA

The GMA consists of 4 major components, a load cell assembly that is housed inside the FP gauge, ZENO GMA Assembly, Removable Data Media (RDM) and Solar Panel. A single cable

connects the load cell assembly with the ZENO GMA using existing ports on the FP gauge. A 25 foot cable (direct burial and shielded) is provided with the GMA to support the MTTS thermistor. A cable connects the solar panel with the ZENO GMA.

1.1.1.1 Load Cell Assembly

The load cell assembly includes the load cell assembly, plunger and mounting hardware. The load cell assembly replaces the weighing mechanism of the FP gauge. The output of the load cell is proportional to the weight of the water accumulated in the precipitation gauge. The ZENO®–3200 datalogger housed in the ZENO GMA provides regulated excitation to the load cell. Output is read on a low-voltage analog input channel.

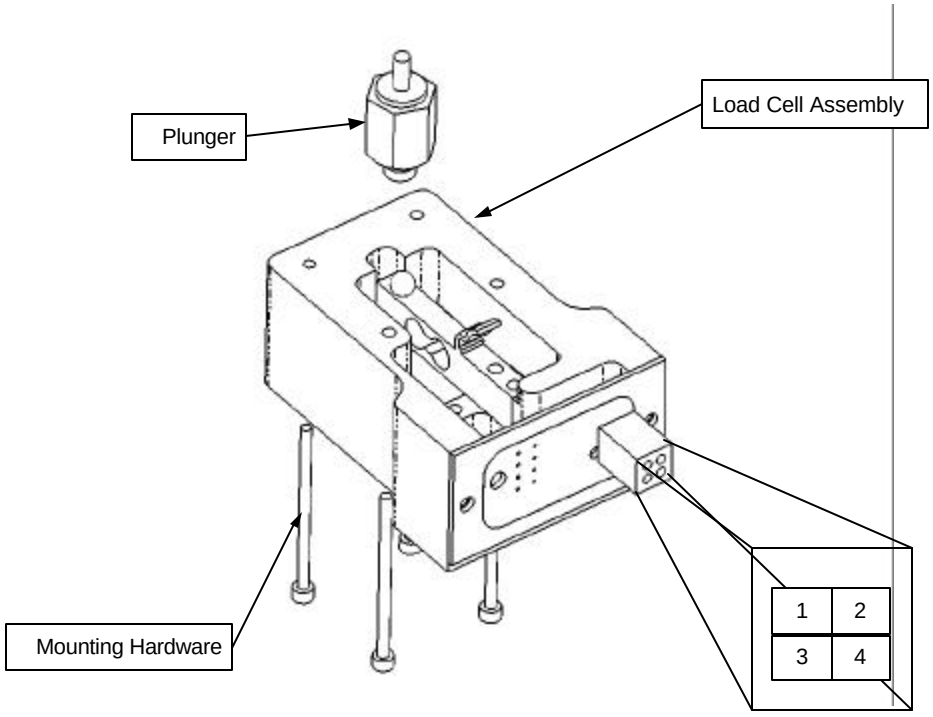

Figure 1-1. Load Cell Assembly

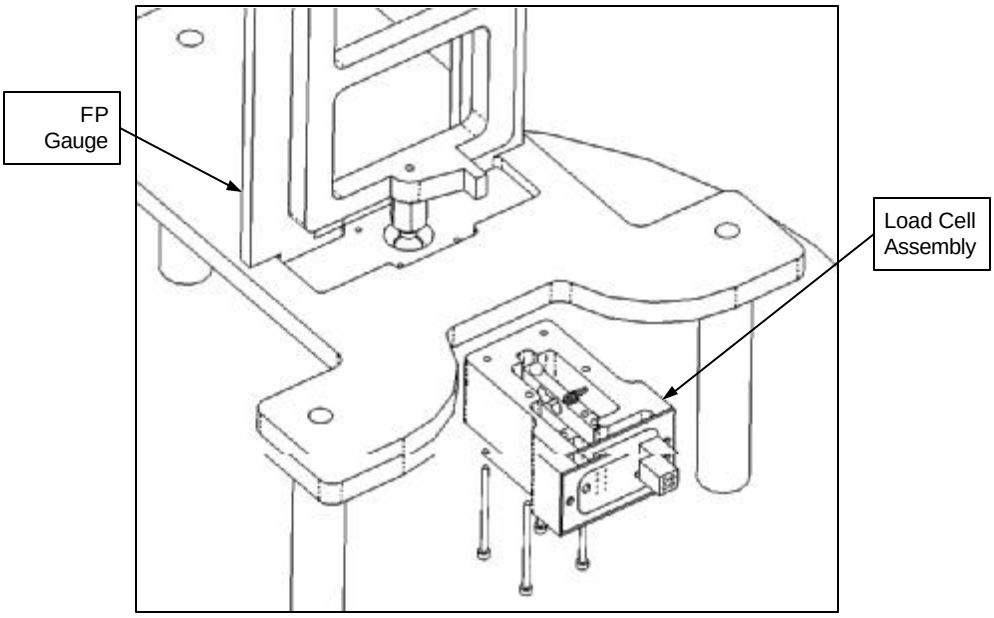

Figure 1-2. Installation of Load Cell Assembly

1.1.1.2 GMA Enclosure

The GMA Enclosure houses the ZENO GMA Assembly, battery, battery cable and battery charger Printed Circuit Assembly (PCA). It is a stainless steel box that may be pole mounted. Pole-mounting hardware include a stainless steel pole hook and two U-bolts with spacers that can be used to mount the enclosure on a 2" to 3" diameter pole. GMA Enclosure is part of the chassis ground.

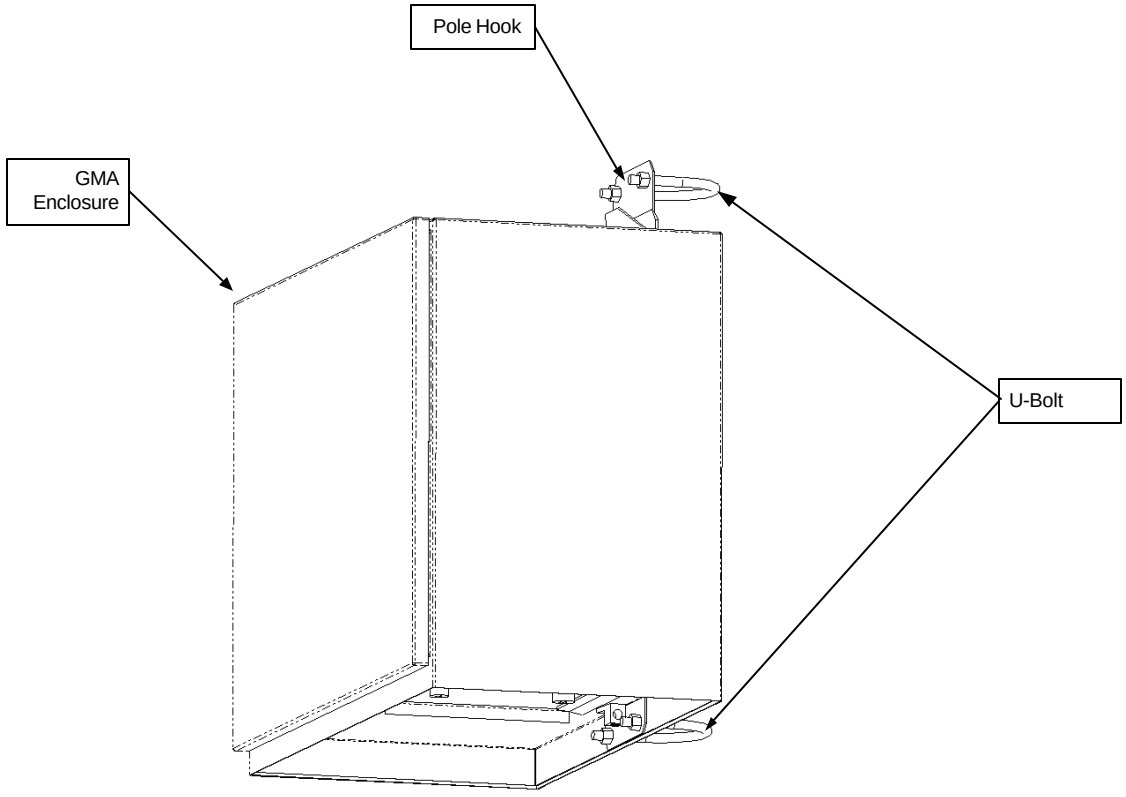

Figure 1-1. GMA Enclosure with Mounting Hardware

1.1.1.2.1 ZENO GMA Assembly

The ZENO GMA Assembly includes the battery charger PCA, ZENO®–3200 CPU board, DataKey™ receptacle, 4x20 Vacuum Fluorescent Display (VFD), weatherproof keypad, and may include a radio assembly. Except for the battery charger PCA, components within the ZENO GMA Assembly are not field replaceable. The ZENO GMA gets its power from the battery via the Battery Charger PCA. There are two ground planes in the ZENO GMA, Signal Ground (battery - terminal) and Chassis Ground (transient protection ground reference). Signal ground and chassis ground connect at the plated hole for the antenna.

The ZENO®–3200 CPU board acquires data from the sensors, converts the data to engineering units, calculates averages and stores data. The ZENO®–3200 is also used to carry out self-tests and will perform quality checks on the data.

The DataKey™ receptacle is where the RDM is inserted to retrieve data. The RDM are DataKeys. When the key is turned, the stored data is uploaded onto the DataKey.

The VFD is used in both the GMA and DCOM (if present). Data are displayed on a 4x20 character display. The display becomes illuminated when the system is powered up. After a preprogrammed amount of time, the display will turn off. The display may be activated by pressing any key.

The radio (if present) is a Zeus spread spectrum radio. It is used with an omni-directional antenna (other antennas may be used) to provide line-of-sight communications with the DCOM.

If the ZENO GMA Assembly is equipped for radio communications with the DCOM, two 2.4 GHz, 4 DBI omni-directional antenna will be provided. Other antennas are available.

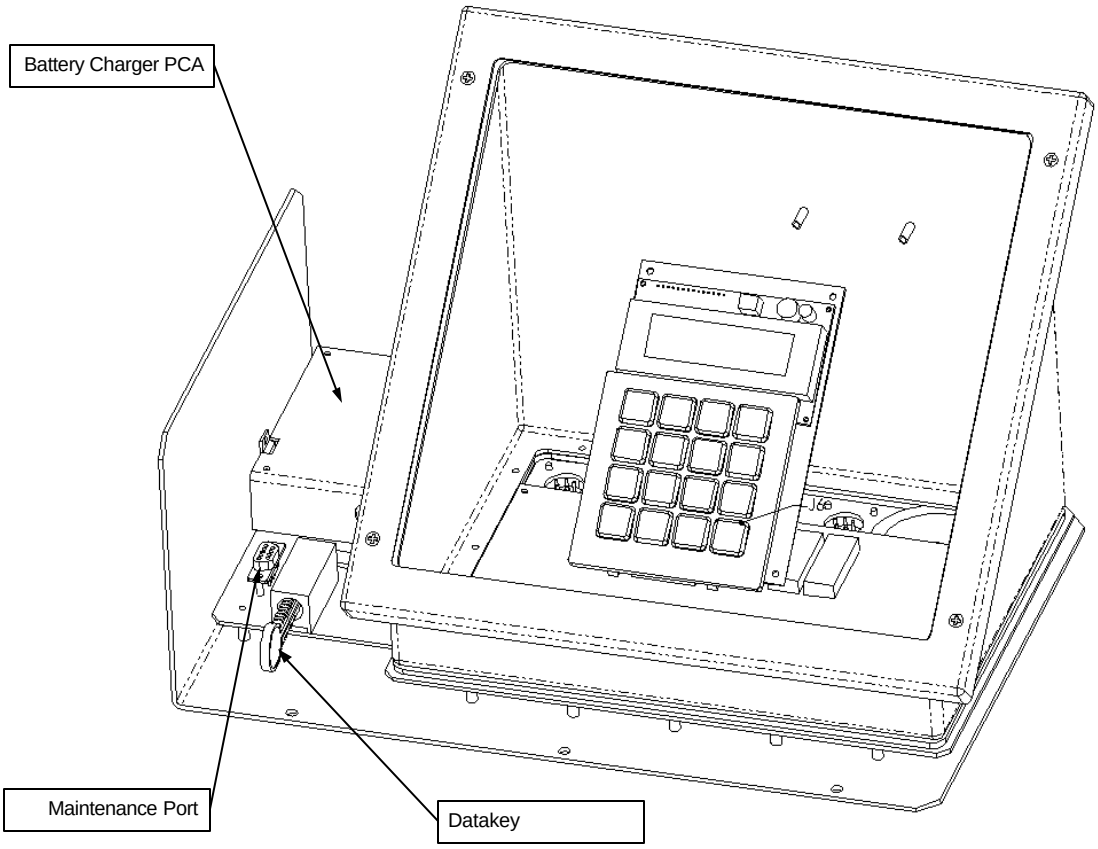

Figure 1-1. ZENO GMA Assembly

A serial port connector is located on the front of the ZENO GMA Assembly for maintenance. The serial port connector is a DSUB-9 female connector.

The Battery Charger PCA is a field replaceable unit. It provides the interface between the ZENO GMA Assembly, battery and solar panel. There is a replaceable 5A fuse within the battery charger PCA that is accessible from the front of the battery charger PCA.

Connectors for the load cell cable, solar panel cable, thermistor cable, and shaft encoder cable are provided on the underside of the ZENO GMA Assembly. If the ZENO GMA Assembly is equipped with a radio, it will also have an antenna connector. The antenna connector is a reverse threaded SMA female bulkhead.

1.1.1.2.2 Battery and Battery Cable

The battery is a 12VDC, 84AH deep cycle battery. The battery connects to the battery charger PCA using an internal battery cable. For standard conditions, it is housed in the GMA enclosure. In extreme environments, the battery and battery charger PCA are housed in the EEv enclosure and may need to be buried.

1.1.1.3 Removable Data Media

The Removable Data Media (RDM) are DataKeys™. The DataKey™ is a key shaped device that fits into a receptacle on the ZENO GMA Assembly. These are durable and cannot be used incorrectly. Each key will hold approximately 88 days of data. Two keys are provided with the ZENO GMA Assembly.

Figure 1-1. DataKeys™

1.1.1.4 Solar Panel and Solar Panel Cable

The solar panel is a Seimens ST-20. This is a 12 VDC, 20 watt panel. The single crystalline solar cells are laminated between a multi-layered polymer back sheet and layers of ethylene vinyl acetate (EVA) for environmental protection, moisture resistance, and electrical isolation. The ultra-clear tempered glass provides excellent light transmission and protects from wind, hail and impact. The panel is mounted in a torsion and corrosion resistant anodized aluminum frame. Mounting hardware is provided with the solar panel. A Coastal Environmental solar panel cable connects the solar panel to the ZENO GMA Assembly. The solar panel itself also has a cable, which must be terminated and connected to the solar panel cable via the provided breakout box and terminators. This will be done in the field by the installation technician.

1.1.2 EEv Enclosure

A separate EEv Enclosure is used with the GMA when temperatures are expected to go below –20° C. The EEv Enclosure houses a 12V 84AH deep cycle battery, battery charger PCA, and battery cable. A direct burial cable connects the EEv Enclosure to the ZENO GMA Assembly. A second direct burial cable connects the EEv Enclosure to the Solar Panel. The EEv Enclosure may need to be buried when temperatures are expected to go below –20 Deg C. It is up to the installer to maintain the temperature of the battery above –20 Deg C. Table 2-1 provides guidance as to burial depth.

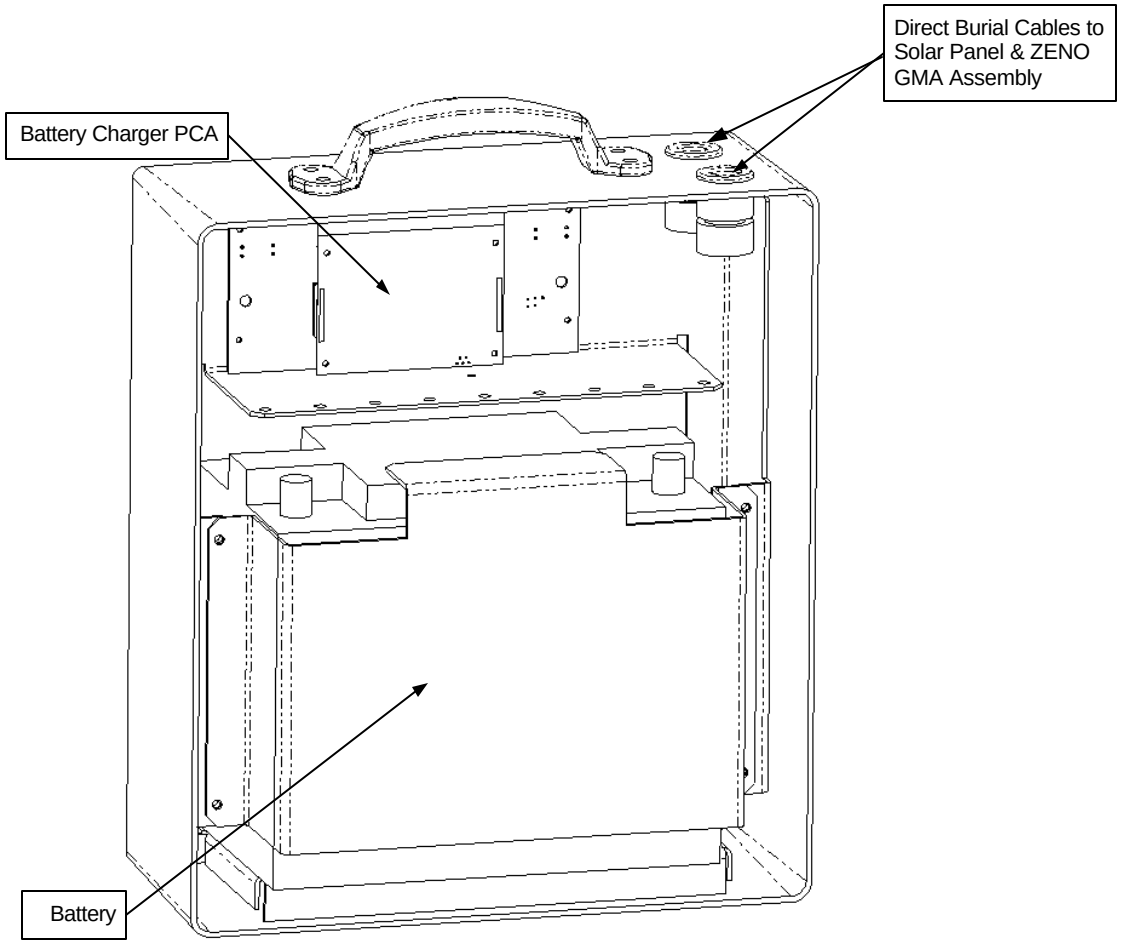

Figure 1-1. EEv Enclosure

1.1.3 ZENO DCOM

The ZENO DCOM provides a data display and acts as a data transmittal device from the GMA to NWS. The ZENO DCOM includes a display identical to the ZENO GMA display, a radio identical to the ZENO GMA radio, omni-directional antenna (or other antenna) identical to the antenna at the ZENO GMA, and a telephone modem. An AC power cord is provided with the DCOM. There is a 0.75A fuse located at the AC receptacle on the back of the ZENO DCOM. Other than the power cord, fuse and antenna, none of the DCOM components are field replaceable.

A serial port connector is provided on the front of the ZENO DCOM for maintenance.

There is a push button located on the front of the ZENO DCOM that is used to send data via the telephone modem. The telephone cable is not provided with the ZENO DCOM.

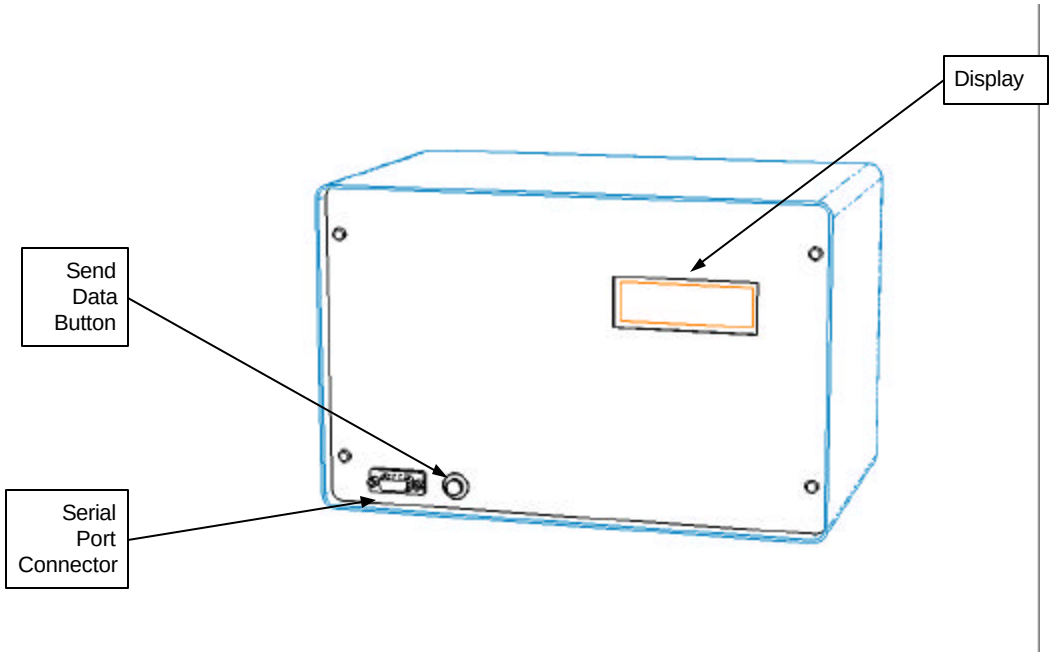

Figure 1-1. DCOM Front View

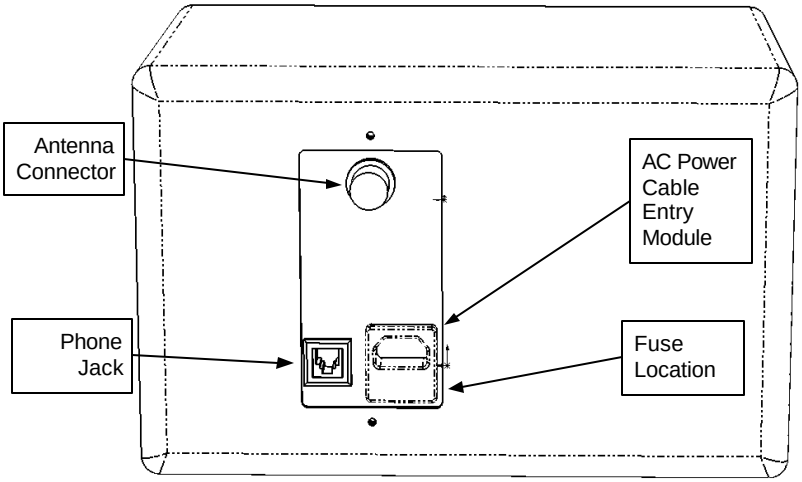

Figure 1-2. DCOM Rear View

1.2 THEORY OF OPERATION

1.2.1 Precipitation Data

The load cell measures the weight of the amount of precipitation in the FP gauge. A measurement will be made every 10 seconds, and the latest value will be displayed at all times. This display will normally occur within 1 second of the measurement being carried out.

A one-minute average, P1m, will be constantly updated. This value will be transmitted to the DCOM for display (if present), and will be returned whenever a request for current data is made over the maintenance port or the radio.

A five-minute average, P5m, will be calculated at each quarter-hour. This value will be archived as P15m.

Each 24 hours – at a time of day defined in the configuration file, with a default at midnight – the difference will be found between the current average P5m and the average 24 hours earlier. This value will be archived at P24d, together with the current value of P5m.

Default display units for precipitation are inches of water. Default output units are also inches of water.

1.2.2 Ambient Temperature Data

A measurement will be made every 10 seconds, and the latest value will be displayed at all times. This display will normally occur within 1 second of the measurement being carried out.

A one-minute average, T1m, will be constantly updated. This value will be transmitted to the DCOM for display (if present), and will be returned whenever a request for current data is made over the maintenance port or the radio.

At each hour, on the top of the hour, the current value of T1m will be archived, together with the hourly maximum and minimum values Th-max and Th-min of the ambient temperature and the times at which those maximum and minimum values occurred.

Each 24 hours – at a time of day defined in the configuration file, with a default at midnight – the hourly maximum and minimum values Th-max and Th-min of the ambient temperature and the times at which those maximum and minimum values occurred will be archived, together with the current value of T1m. It can be configured such that the time of day for temperature can be different from the time of day for precipitation, if required.

Default display units are degrees F. Default output units are degrees C.

1.2.3 Shaft Encoder Data

The shaft encoder and shaft encoder cable are provided by NWS. Refer to NWS provided documentation for the shaft encoder.

Display default units and output default units are feet.

1.2.4 Sensor Notations

Any sensor notation entered by the operator will be archived, together with the date and time at which it occurred.

1.2.5 Data Formats

Messages archived by ZENOSOFT™ can include arbitrary labels and data descriptions – which are extremely useful in later data quality analyses.

1.2.6 Data Storage

Data storage occurs in the ZENO GMA or ZENO DCOM in "flash memory."

2. INSTALLATION

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Installation procedures do not require any special tools. Items needed for installation and checkout include the instructions for installation, existing calibration weights, voltmeter (or multimeter) and typical mechanical tools such as screwdrivers (Phillips and flat blade), open end wrenches, socket wrenches and allen wrenches. All tools are SAE standard sizes.

A laptop computer with a terminal emulation program such as HyperTerminal or ProComm and a straight through DB9M to DB9F communications cable are needed to enter site specific information and communicate with the ZENO GMA and ZENO DCOM through the laptop port.

If the system is equipped with the ZENO DCOM, a standard telephone cable with RJ-11 connectors on each end is required for telephone communications.

Spacers may be required if mounting pole is less than 3" in diameter.

Before beginning installation, unpack all equipment and verify that all necessary pieces are present. Refer to the packing list. The FP Upgrade includes the GMA Enclosure with ZENO GMA, Mounting Hardware, Battery, Internal Battery Cable, Load Cell Assembly, Load Cell Cable, Solar Panel, Solar Panel Mounting Hardware, Solar Panel Cable, 2 DataKeys and Technical Manual. For systems with DCOM units, the ZENO DCOM, AC power cable and two omnidirectional antennas are included, and the ZENO GMA will be a ZENO GMA-Radio. If the system is to be installed in extreme environments, an EEv enclosure will also be provided.

2.1 GMA

The Load Cell Assembly is installed inside FP gauge. All the equipment that interfaces to the FP gauge is mounted to existing threaded holes. Supporting electronics are housed in a stainless steel enclosure. The enclosure and solar panel and are designed to be pole mounted.

To install the GMA:

1. Position the GMA Enclosure facing North. The GMA Enclosure may be pole-mounted using the Mounting Hardware. Using a 9/16" socket, attach the Pole Hook Bracket to the pole using one of the U-bolts. The U-bolts are sized for a 3" diameter pole. Use spacers as required if pole is less than 3" diameter. Hang the System Enclosure from the pole hook. Secure the bottom of the System Enclosure to the pole using the remaining U-bolt.

Torque to hand tight, do not overtighten to the point where enclosure sheet metal begins to deform.

2. Mount Solar Panel on pole using solar panel manufacturer's supplied pole mounting hardware. Make sure that the Solar Panel faces South and is not shaded by trees or other obstructions. Following instructions provided with Solar Panel Mounting hardware and section 3.2, adjust the solar panel to 30, 45 or 60 degrees as determined by Table 3-1.

NOTE

Please verify that FP Gauge is installed per: *The precipitation gauge will be mounted so that the orifice is horizontal and in an area where the terrain is relatively flat. The orifice is defined as the upper rim edge of the collector mouth. The height of the orifice will be as close to ground level as practicable. In determining the height of the orifice, consideration will be given to keeping the orifice above accumulated/drifting snow and minimizing the potential for splashing into the orifice. Surrounding objects will be no closer to the gauge than a distance equal to two times their height above the gauge orifice. An object is considered an obstruction if the included lateral angle from the gauge to the ends of the object is 10 degrees or more. In order to reduce losses due to wind, an alter-type windshield is recommended to be installed on gauges in areas where 20 percent or more of the annual average precipitation falls as snow. The surrounding ground can be covered with short grass or be of gravel composition, but a hard flat surface, such as concrete, gives rise to splashing and should be avoided. Separate gauges may be used to measure liquid and frozen precipitation accumulation (e.g., rain and snow) in which case the above criteria will be followed for each installation.* From FCM-S4-1994.

3. System Enclosure and Solar panel shall be installed at least <12" below orifice of the gauge when within 10 ft of the gauge. They also shall not be mounted in such a way as to form a wind fence that shields the F&P gauge or allows snow to collect and shield or form a bridge to the gauge.
4. Remove hood of FP gauge.
5. Drain bucket of any fluids.
6. Remove bucket and remove lower shell.
7. Remove the zero adjust knob, iso-elastic spring, tension spring, damper, paper punch mechanism, paper supply spool, and gauge indicator. All that will be left is the support arm assembly, scale support, and cantilever beams. This can be done without removing lower case, but if desired, lower case can be removed for ease of access.
8. Inspect flexures per NWS procedures.
9. Clean off the area where the damper gasket mates to the gauge. Make sure there is no residual damper oil, dirt, or leftover chads.
10. Clean off the area where the damper rod mates to the support arm assembly. Make sure there is no residual damper oil, dirt, or leftover chads.
11. Install the plunger part of Load cell assembly by screwing plunger into support arm assembly in hole where damper rod was mounted.

12. If plunger is not centered on damper hole, loosen 4 scale support bolts and move scale support to center plunger on damper hole. Tighten 4 scale support bolts.
13. Adjust support arm stop screws so that plunger bottom surface is above plane of damper gasket mating surface. Do not lower support arm stop until instructed to do so in later installation instructions.

CAUTION

Use care when handling the load cell assembly. Do not scratch the surface of the load cell.

14. Install the Load Cell Assembly using four 4-40 socket head bolts. The four bolts screw into existing damping reservoir threaded holes. Finger tighten with 3/32" allen wrench.
15. Feed the load cell cable end with plastic connector through a threaded hole in base of gauge.
16. Connect the Load Cell Cable plastic connector to the load cell assembly PCB. There is only one connector and it is keyed and latched. The latch on the connector faces down. Connect the other end of the cable to the underside of system enclosure. All connectors on system enclosure are keyed. There is no way to misconnect cables. See connector diagram in Technical Manual and on the inside of enclosure door.
17. If equipped, remove dust cap and connect the Thermistor Cable to Thermistor and underside of system enclosure.
18. If equipped connect the shaft encoder cable to the shaft encoder and to underside of system enclosure.
19. If the system is equipped with a radio and DCOM, attach the Antenna to underside of System enclosure onto reverse thread female SMA bulkhead connector.
20. Remove 12V battery from packaging. Remove terminal covers. Using a ½" wrench, attach Internal Battery Cable to battery terminals. Red wire to red (+) terminal. Black wire to black (-) terminal. Replace terminal covers.
21. Open the System Enclosure.
22. Place the 12V Battery in the system enclosure to the left of the electronics enclosure with terminal side close to GMA electronics enclosure. Connect the Internal Battery Cable to the GMA Interface Board. There is only one connector capable of connecting the battery cable to. It is keyed and latched.
23. Cut the cable that comes with the solar panel to desired length and strip the ends. Insert end into solar panel cable connector box. Crimp push-on connectors onto stripped cable ends. Connect connectors with solar panel cable connectors inside the solar panel cable connector box.. Using tie wraps, strain relief the solar panel cable on the inside and outside of the solar panel cable connector box. Trim tie wraps. Screw cover on box.
24. At this point the load cell assembly is installed, the plunger piece is aligned over the load cell, all cables are connected and the system is powered on. The display should be illuminated. The GMA should now automatically start making measurements, logging data, and if so equipped transmitting data to the DCOM.
25. Following the procedures in section 3.1, calibrate the load cell.

26. Enter the site specific parameters following the setup procedures in section 3.3.
27. Perform GMA Functional Test using the procedures provided in section 3.4.
28. Close the System Enclosure. GMA is installed and operating.

2.2 DCOM

The DCOM comprises the ZENO DCOM, AC Power Cord, and DCOM Antenna. The ZENO DCOM is used only with a ZENO GMA that is radio equipped. Installation procedure assumes that ZENO GMA is installed and powered up. Installation procedure for the DCOM is as follows:

1. Place the ZENO DCOM in an indoor or sheltered location with line of sight visibility to ZENO GMA Antenna. If indoors, this is commonly done through a window. If this cannot be achieved, an external antenna cable and higher performance antenna may be required.

NOTE

If the ZENO DCOM cannot be placed in a location that provides line of sight visibility to ZENO GMA antenna, an external antenna and external antenna cable may be used. There are two external antenna options. One is a higher performance omni-directional antenna, the other is a high performance directional antenna. They both connect to the external antenna cable. The external antenna cable is 15 feet long. When using an external antenna, ONLY the external antenna need have line of sight visibility to ZENO GMA antenna.

2. Connect the Antenna to the back of the ZENO DCOM. The antenna is a reverse thread SMA connection.
3. Connect a phone cable to a phone jack and back of ZENO DCOM
4. Attach AC Power Cord to the ZENO DCOM AC power receptacle.
5. Plug the AC Power Cord into an 110V AC outlet. The ZENO DCOM display will be illuminated, showing a splash screen, when the AC power cord is plugged into an AC outlet.
6. At this point in time the DCOM is waiting to receive radio transmissions from the GMA. When received, the DCOM will begin logging and displaying them. Until transmission is received from the GMA, data will appear as "_____". The DCOM is accessible from an outside phone dialup, and the download button on the front of the DCOM is enabled for automated dial-out sequence.
7. Enter the site specific parameters following the setup procedures in section 3.5
8. Perform DCOM Functional Test using the procedures provided in section 3.6.

2.3 EEV ENCLOSURE

The EEv Enclosure contains a fiberglass enclosure, with internal EEv interface board, battery hold down, latch securing plastic clips, and Jumper Block PCA. EEv interface board is mounted inside enclosure. The EEv Enclosure is provided for burial in extreme environments. This

installation process assumes that the normal environment FP upgrade system is already installed and completed. The process to install the EEv battery enclosure is as follows:

1. Disconnect internal battery cable from ZENO GMA Assembly.
2. Remove the battery and internal battery cable from the GMA Enclosure.
3. Remove the Battery Charger PCA from ZENO GMA. See section 5.3.2.6 for Battery Charger PCA remove/replace instructions.
4. Insert Jumper Block PCA into Battery Charger PCA location in ZENO GMA. Remove/replace procedures for the Jumper Block PCA are the same as for Battery Charger PCA. Install mounting hardware and cover.
5. Following procedures in 5.4.6, install Battery Charger PCA into EEv enclosure onto EEv interface board. Install Mounting Hardware.
6. Place Battery in EEv enclosure.
7. Install battery hold down strap with mounting hardware. When installed, battery should be held in place with only a small amount of battery movement occurring.
8. Connect Battery Cable to EEv Interface Board.
9. Close and secure EEv enclosure latches with plastic clips.
10. Disconnect Solar Panel cable from underside of system enclosure.
11. There are two cables coming from the EEv Enclosure. Connect one EEv cable to solar panel cable. Connect the other EEv cable to the underside of ZENO GMA. Connectors on EEv cables are keyed such that there is no way to incorrectly connect cables.
12. Bury or place EEv enclosure in environment that will not go below –4 Degrees Fahrenheit. It is suggested that the enclosure be laid down when buried such that the cables enter the enclosure parallel to the earth.

NOTE

EEv enclosure is waterproof and capable of being buried.

The Table 2-1 may be used as a guide in determining burial depth.

Date	Air Max	Air Min	Snow Depth	Soil 4"	Soil 8"	Soil 20"	Soil 40"
1/21/1989	-15	-34	18	22	25	30	31
1/22/1989	-22	-49	18	21	24	30	31
1/23/1989	-15	-47	20	17	20	28	31
1/24/1989	-12	-27	20	18	20	28	31
1/25/1989	-2	-14	22	18	20	28	31
1/26/1989	-2	-16	22	19	20	28	31
1/27/1989	-7	-20	23	20	21	28	31
1/28/1989	-18	-36	23	19	20	28	31
1/29/1989	-16	-30	22	19	21	28	31
1/30/1989	-12	-26	22	19	21	28	30
1/31/1989	-14	-44	22	19	21	28	30
2/1/1989	-27	-48	22	18	21	28	30
2/2/1989	-27	-51	22	17	20	26	29
2/3/1989	-21	-47	22	16	20	24	29
2/4/1989	-19	-43	22	16	20	25	29
2/5/1989	-9	-37	22	16	20	26	29

Date	Air Max	Air Min	Snow Depth	Soil 4"	Soil 8"	Soil 20"	Soil 40"
2/6/1989	-8	-35	22	16	19	26	29
2/7/1989	-3	-27	22	16	19	26	29
2/8/1989	1	-16	22	17	19	26	29
2/9/1989	14	-7	23	18	19	26	29

Table 2-1. Burial Depth

3. SETUP

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3.1 LOAD CELL CALIBRATION PROCEDURES

Load cell calibration must be done with access into the Zenosoft menu structure. Access the user menu via a method specified in section 3.3.2.

At the '>' prompt, type 't' followed by hitting the enter key. You should be presented with the Test menu similar to what is shown below:

```
TEST MENU
(Rx,y) Display Sensors x-y RAW Data          (Ex) Display Sensor x Error Codes
(Sx,y) Display Sensors x-y SCALED Data       (P)  SDI-12 Pass-Through Mode
(Cx)   Calibrate Sensor Record x             (U)  User Menu
(Vx)   View Process Record x                 (Q)  Quit
(D)    View Data Collection Counters         (H)  Help
(B)    Display BIT Status
```

At the '>' prompt, type 'c1' followed by hitting the enter key. This is a request to Calibrate sensor number one.

You should be presented with the sensor name, the current 'A' conversion coefficient, and a prompt to enter a new 'A' conversion coefficient. At the prompt enter '0' (zero) and press enter.

```
Sensor Name: RainWeight
Conversion Coefficient A: 0
Enter new Conversion Coefficient A: 0
```

Similarly, you will be presented with the current 'B' coefficient and prompted for a new value. For this value type '1000' (one thousand) and press enter:

```
Conversion Coefficient B: 1256.6
Enter new Conversion Coefficient B: 1000
```

Finally, you will be presented with the current 'C' coefficient and prompted for a new value. For this value type '0' (zero) and press enter:

```
Conversion Coefficient C: -4.92398
```

```
Enter new Conversion Coefficient C: 0
```

After entering the new ‘C’ coefficient value, you should be back at the test menu.

Remove all fluids and weights from the bucket. Make sure the plunger is touching the load cell ball bearing and the full weight of the bucket assembly is on the load cell.

At the test menu prompt type ‘s1,1’ followed by enter. This will result in the output of sensor measurements for the first sensor (precipitation weighing sensor) every second:

The value presented should change every six seconds (six readings) or so. Allow this to run for at least 60 seconds and then hit the enter key to halt the update. Record 10 values and average them. The averaged value is known as the empty weight, B1. The test menu will return:

Place the 3 large weights in the bucket. Type ‘s1,1’ <enter>. After 60 values hit <enter> to halt the update. Record 10 values and average them. This value is the 15" weight, B2. The test menu will return:

Calculate new B. B = 15000/(B2-B1). Type ‘c1’ at the prompt to enter new calibration. Enter B value for coefficient B, leaving A & C as zero. After entering, the test menu returns:

Remove all weights from the bucket. Now that the true gain of the system is entered, B, we will use the system to measure the weight of the empty bucket and use that value as an offset to make the system indicate ZERO when the bucket is empty.

At the test menu prompt type ‘s1,1’ followed by enter. After 60 values hit the enter key to halt the update. Record 10 values and average them. This value is the offset, C1. Again the test menu will return.

Calculate new C. C = - C1. NOTE the negative sign... enter C1 as a negative number.

Type ‘c1’ at the prompt to enter new calibration. Leave A & B as is, enter C for coefficient C. After entering coefficients, you should be back at the test menu.

With the bucket empty, type 's1,1<ent>', and verify these values are 0.00 ±0.1.
Place the 3 large weights (15 inches equiv. precipitation) in the bucket.
Verify that these values are 15.00 ± 0.1 inches. Press <enter> to return to the test menu.

If the above readings of zero and 15" are within tolerence, continue below to save the coefficients to memory. If not within tolerence, redo the calibration, or seek help from your technical advisor.

We should be at the test menu still. Type ‘u’ to enter user menu. Type ‘c’ to enter communications menu.

```
COMMUNICATIONS MENU
(Cn/m) Change Item n To Value m          (R)  Repeater Menu
(M)    Modem Menu                        (Tn) Terminal Mode On COM Port n
(P)    Power Control Menu                (E)  Save Parameters To EEPROM
(G)    GOES Menu                         (U)  User Menu
(A)    ARGOS Menu                        (Q)  Quit
(D)    Digital Control Menu              (H)  Help
Item  1:  9600       (COM1 Baud Rate)
Item  2:  RS232      (COM1 Port Type)
```

```
Item  3:  8          (COM1 Data Bits Per Character)
Item  4:  1          (COM1 Start Bits)
Item  5:  1          (COM1 Stop Bits)
Item  6:  NONE       (COM1 Parity)
Item  7:  9600       (COM2 Baud Rate)
Item  8:  RS232      (COM2 Port Type)
Item  9:  8          (COM2 Data Bits Per Character)
Item 10:  1          (COM2 Start Bits)
Item 11:  1          (COM2 Stop Bits)
Item 12:  NONE       (COM2 Parity)
Item 13:  9600       (COM3 Baud Rate)
Item 14:  RS232      (COM3 Port Type)
Item 15:  8          (COM3 Data Bits Per Character)
Item 16:  1          (COM3 Start Bits)
Item 17:  1          (COM3 Stop Bits)
Item 18:  NONE       (COM3 Parity)
Item 19:  COM1,COM2  (COM Ports to Exclude from User Interface)
Item 20:  NO         (Enable Exclusive CCSAIL Access)
```

Type ‘e’ to save calibration values to EEPROM. Screen should appear as below and return to communications menu.

```
Verifying parameters can be stored in EEPROM .  .  .
Saving parameters to EEPROM .  .  .
Saving sensor lists to EEPROM .  .  .
Saving process lists to EEPROM .  .  .
Saving data output lists to EEPROM .  .  .
Saving repeater lists to EEPROM .  .  .
Saving general serial scripts to EEPROM .  .  .
Saving constants to EEPROM .  .  .
1057 out of 8192 bytes used in EEPROM.
Total EEPROM Writes = 17, EEPROM Checksum = 200.
```

Type ‘q’ to quit Zenosoft menus. Calibration procedure is done.

3.2 SOLAR PANEL SETUP

The solar panel may be adjusted to 30˚, 45˚ or 60˚. Detents are provided on the mounting hardware for 30˚, 45˚ or 60˚. Optimum mounting angle of the solar panel is dependent on the latitude of the location of the solar panel. Tilt angle is the amount of angle away from solar panel facing directly up. An approximate rule of thumb is provided for calculation of tilt angle. An approximate rule of thumb is provided in Table 3-1 for the tilt-angle calculation.

Table 3-1. Solar Panel Tilt/Latitude

Latitude of Solar Panel	Tilt Angle of Panel
0-4 degrees	10 degrees
5-20 degrees	latitude + 10
21-46 degrees	latitude + 11

3.3 GMA SETUP

To physically access setup menus in the GMA, you have three options. Use the laptop port on the GMA, use the laptop port on the DCOM and access the GMA via radio link, or use the telephone modem in the DCOM and access the GMA via radio link. In each case when you've reached the GMA user menu, you are at the point where you can change the setup.

3.3.1 Accessing the User Menu

3.3.1.1 Access via Laptop Port

The simplest and most direct way is accessing via laptop port. To do this, you will need a computer with a terminal emulation program such as ProComm or HyperTerminal and a straight through DB9M to DB9F cable. Connect the serial cable to the DB9F on the ZENO GMA, connect the other end to your computer's serial port.

Set up the terminal emulation program using the settings provided in Table 3-1:

Table 3-1. Communications Settings

Parameter	Value
Baud rate	9600
Start bits	1
Stop bits	1
Data bits	8
Handshaking	none
Parity	none

After connecting, type **U**, followed by the **<ENTER>** key, to enter the `User` Menu. The ZENO will prompt for a password. Enter the password, "ZENO". The ZENO will display the menu structure shown in Figure 3-1.

```
USER MENU
(C) Communications Menu          (T) Test Menu
(F) System Functions Menu        (Z) Zeno Program Menu
(S) Sample Period Menu           (Q) Quit
(D) Data Retrieval Menu          (H) Help
```

Figure 3-1. User Menu

Type 'f' to enter system functions menu. Type 'v' to view software version. The correct firmware version number, date and time is V1.966-2637-GMA-1.1 MAY 2 2002 09:49:28 CS 6D02. This verifies that you are accessing the GMA.

Type 'u' to return to user menu.

3.3.1.2 Access via DCOM Laptop Port

Connect the serial cable to the DB9F on the ZENO DCOM front panel, connect the other end to your computer's serial port.

Set up the terminal emulation program as in Table 3-2.

After connecting, type **U**, followed by the **<ENTER>** key, to enter the User Menu. The ZENO will prompt for a password.

Type 'f' to enter system functions menu. Type 'v' to view software version. The correct firmware version number, date and time is V1.966-2637-DCOM-1.1 MAY1 2002 13:44:10 CS 31C5. This verifies that you are accessing the DCOM user menu.

Type 'c' to enter communications menu. Set pass-through mode on com1, Rs232 format. Type u to access ZENO-GMA menu. NOTE: This step requires a radio equipped GMA powered on with antenna installed. Verify that you are accessing the GMA by checking the date and firmware version number (see 3.3.1.1)

3.3.1.3 Access via DCOM Telephone Modem

To access the DCOM via telephone modem, you will need a terminal program operating on a computer equipped with a modem. Dial into telephone number DCOM is plugged into. Once connected, type "u" to enter DCOM user menu. Type "c" to enter communications menu. Type "t1" to set pass-through mode on com1. Rs232 format. Type "u" to access ZENO-GMA menu. NOTE: This step requires a radio equipped GMA powered on with antenna installed. Verify that you are accessing the GMA by checking the date and firmware version number (see 3.3.1.1).

You are now accessing the GMA user menu.

3.3.2 Entering Site Information into ZENO GMA

Access the GMA User menu via one of the methods described above in Section 3.3.1. Once at the user menu, type "F"<enter> to access system functions menu. Type "c1/abcd"<enter> where abcd is 4-character numeric and case sensitive. Type "c2/abcd"<enter>' where again abcd is four character numeric and case sensitive. These two values allow an 8-character code for specific site identification.

Type "e"<enter> to save site information in non-volatile memory. Type "q"<enter> to exit.

3.3.3 Entering Calibration Coefficients into ZENO GMA

Calibration coefficients for precipitation sensor and shaft encoder can be entered into the ZENO GMA via the user menu.

3.3.3.1 Entering Load Cell Calibration Coefficients into ZENO GMA

This section describes how to enter known load cell calibration coefficients into a GMA. For initial load cell calibration, please refer to section 3.1.

Access the GMA User menu via one of the methods described above in Section 3.3.1. Once at the user menu, type "z"<enter> to access Zeno program menu. Type "s"<enter> to access sensor menu. Type "j1"<space>"c14/number"<enter>, where number is any real number. This sets the precipitation sensor

gain factor for volts to inches. Invalid numbers or combinations will cause an error. Retry with a different value if an error message is displayed.

Type “j1”<space> “c15”/number<enter>, where number is any real number. This sets the precipitation sensor offset in inches.

Once calibration is complete, type “z”<enter> to exit sensor menu. Type ‘e’<enter> to save calibration values. Type “q”<enter> to exit program menu.

3.3.3.2 Entering Shaft Encoder Calibration Coefficients into ZENO GMA

This section describes how to enter known shaft encoder calibration coefficients into a GMA. Calibration coefficients for shaft encoder are pulse count to stream height and stream height initial value. Values for shaft encoder gain and offset are determined by NWS shaft encoder configuration.

Access the GMA User menu via one of the methods described above in Section 3.3.1. Once at the user menu, type “z”<enter> to access Zeno program menu. Type “s”<enter> to access sensor menu. Type “j3”<space>”c14/gain”<enter>, where gain is the shaft encoder to feet conversion factor. This sets the shaft encoder gain factor for pulse count to feet of stream height. Invalid numbers or combinations will cause an error. Retry with a different value if an error message is displayed.

Type “j3”<space> “c15”/number<enter>, where number is any real number. This sets the shaft encoder stream height offset in feet. Invalid numbers or combinations will cause an error. Retry with a different value if an error message is displayed.

Once calibration is complete, type “z”<enter> to exit sensor menu. Type ‘e’<enter> to save calibration values. Type “q”<enter> to exit program menu.

3.3.4 Updating Configuration of ZENO GMA

Uploading a new configuration will delete all currently logged data records as well as the previous configuration. Updating the configuration files of the ZENO GMA can be done from the user menu. First access the GMA user menu as described in Section 3.3.1.

Type “z”<enter> to access program menu. Type “l”<enter> to access system load menu.

Two types of configuration upload can be performed. ASCII text upload and X-modem protocol file transfer.

Type “r”<enter> to upload ASCII text configuration file. When prompted by the ZENO GMA, use terminal program to upload ASCII text.

Type “xr”<enter> to upload X-modem transfer. When prompted by the ZENO GMA, use terminal program to upload file via X-modem protocol.

If upload does not complete properly, repeat process.

Type “e”<enter> to save configuration to non-volatile memory.

3.4 GMA FUNCTIONAL CHECKOUT

Functional Test for GMA follows:

1. Push the X or ENT key on keypad. Display should light up. Verify display is operational.

2. Place a reference weight into precipitation bucket.
3. Verify that display is updating with new measurement data every ten seconds. If the GMA was only recently powered up, there may be no data available. Data will be available at the quarter of the hour of the GMA system clock.
4. Insert datakey into datakey receptacle.
5. Turn datakey ¼ turn clockwise.
6. Watch GMA display for verification of key insert.
7. Watch GMA display for verification of key download.
8. Watch GMA display for notice of key download completion and request for removal.
9. Remove datakey.
10. Verify Display message return to Data display.
11. Access user menu of GMA. See Section 3.3.1.
12. Type "d" <enter> to access ZENO data retrieval menu
13. Type "*" to display all ZENO data records. Look for breaks in the time stamp of data records. Breaks will indicate data not taken.
14. Insert the datakey into datakey reader. View datakey data records with datakey reader software. Compare datakey data records with terminal program data records in previous step. Verify they are the same. Reference Section 4.3.
15. Type "q" <enter> to exit user menu.
16. Set date and time via keypad. Reference Section 4.1.3.
17. Enter Sensor Notations below via keypad. Reference Section 4.1.2.
18. Push 789 on keypad. "789" should display. Now push "ENT". This should generate and error.
19. Push 456 on keypad. "456" should display. Now push "ENT". This should generate and error.
20. Push 123 on keypad. "123" should display. Now push "ENT". This should generate a message that says "Sensor notation accepted".
21. Change display units. Reference Section 4.1.4.
22. Push 'x' on keypad. Display should prompt for change in Rain Units.
23. Push '2' on keypad. Units should be changed to mm.
24. Push 'ENT' to pass through various units change menus. Display should show.

Current Units:
Rain: mm
Temp: °C
Shaft: Feet

Functional check out is complete.

3.5 DCOM SETUP

To access setup menus in the DCOM, you have two options. Use the laptop port on the DCOM or use the telephone modem in the DCOM.

Accessing via laptop port, you will need a laptop computer with a terminal emulation program such as ProComm or HyperTerminal and a straight through DB9M to DB9F cable.

Set up the terminal emulation program as in Table 3-1.

3.5.1 Accessing the DCOM User Menu

3.5.1.1 Accessing the DCOM User Menu via Laptop Port

Connect the serial cable to the DB9F on the ZENO DCOM front panel, connect the other end to your computer's serial port.

Set up the terminal emulation program as in Table 3-1.

After connecting, type **U**, followed by the **<ENTER>** key, to enter the User Menu. The ZENO will prompt for a password.

Type "f" to enter system functions menu. Type "v" to view software version. The correct firmware version number, date and time is V1.966-2637-DCOM-1.1 MAY1 2002 13:44:10 CS 31C5. This verifies that you are accessing the DCOM user menu.

3.5.1.2 Accessing the DCOM User Menu via Telephone Modem

To access the DCOM via telephone modem, you will need a terminal program operating on a computer equipped with a modem. Dial into telephone number DCOM is plugged into.

After connecting, type **U**, followed by the **<ENTER>** key, to enter the User Menu.

Type "f" to enter system functions menu. Type "v" to view software version. The correct firmware version number, date and time is V1.966-2637-DCOM-1.1 MAY1 2002 13:44:10 CS 31C5. This verifies that you are accessing the DCOM user menu.

3.5.2 Entering Site Information into ZENO DCOM

Access the DCOM User menu via one of the methods described above in Section 3.5.1. Once at the user menu, type "F"<enter> to access system functions menu. Type "c1/abcd"<enter> where abcd is 4 character alphanumeric and case sensitive. Type "c2/abcd"<enter> where again abcd is a four character alphanumeric, case sensitive. These two values allow an 8-character code for specific site identification.

Type "e"<enter> to save site information in non-volatile memory. Type "q"<enter> to exit.

3.5.3 Updating Configuration of ZENO DCOM

The process for updating configuration of ZENO DCOM is the same as for ZENO GMA. First you access the DCOM user menu via laptop port or telephone modem.

Type "z<enter> to access program menu. Type "l<enter> to access system load menu.

Two types of configuration upload can be performed. ASCII text upload and X-modem protocol file transfer.

Type “r<enter> to upload ASCII text configuration file. When prompted by the ZENO DCOM, use terminal program to upload ASCII text.

Type “xr”<enter> to upload X-modem transfer. When prompted by the ZENO GMA, use terminal program to upload file via X-modem protocol.

If upload does not complete properly, repeat process.

Type “e”<enter> to save configuration to non-volatile memory.

3.6 DCOM FUNCTIONAL CHECKOUT

Functional checkout is as follows:

Functional Test for DCOM follows:

1. Verify that display is updating on the quarter of the hour. This demonstrates DCOM is receiving radio transmissions from GMA. Time/date will update every 10 seconds, data display is updated every 15 minutes.
2. Press “SEND DATA” button. This and the following 3 steps assume a valid telephone modem at the number that the DCOM is programmed to dial out to.
3. Verify Display message “ Dialing out.”
4. Verify Display message “Sending Data.”
5. Verify Display message “Download Complete.”
6. Verify Display message returns to DCOM Data display.
7. Dial into DCOM using terminal program attached to telephone modem. Type “u” to enter DCOM user menu. Type “c” to enter communications menu. Type “t1” to set pass-through mode on com1. Rs232 format. Type u to access ZENO-GMA menu. NOTE: This step requires a radio equipped GMA powered on with antenna installed. Verify that you are accessing the GMA by checking the date and firmware version number. Type “f” then “v”. The date and firmware version number for the GMA is V1.966-2637-GMA-1.1 MAY 2 2002 09:49:28 CS 6D02
8. Type “q” <enter> to exit GMA user menu.
9. Type “esc” to exit pass-through mode on DCOM Zeno.
10. Type “q” <enter> to exit DCOM user menu.
11. Hang-up Modem connection.
12. Verify DCOM display of GMA data.
13. Plug in a serial extension cable (male dsub-9 to female dsub-9 cable with all signals through) into DCOM front panel dsub9 connector. Plug other end of serial cable into Desktop PC, Laptop PC, or PDA (known as computer).
14. Power on computer. Start operation of terminal program. Set communication parameters to 9600 BAUD, 8 data bits, 1 start bit, 1 stop bit, no parity, no flow control.

15. Enter “u” <enter> on computer. Verify access into ZENO user menu. We are now connected to DCOM’s internal ZENO-3200 CPU. All functions that ZENO is capable of are now accessible.
16. Enter “c” <enter> on computer. Verify you are in communications menu.
17. Enter “t1” on computer. The sets DCOM Zeno to pass thru mode to the DCOM Radio, which is predefined to be on port 1.
18. Type “u” to access ZENO-GMA menu. NOTE: This step requires a radio equipped GMA powered on with antenna installed. Verify that you are accessing the GMA by checking the date and firmware version number. Type “f” then “v”. The date and firmware version number for the GMA is “V1.966-2637-GMA-1.1 MAY 2 2002 09:49:28 CS 6D02.”
19. Type “q” <enter> to exit GMA user menu.
20. Type “esc” to exit pass-through mode on DCOM Zeno.
21. Type “q” <enter> to exit DCOM user menu.

DCOM functional checkout is now complete.

3.7 MODEM SETUP

To setup the modem for dial-out, the phone number and number of records sent can be preprogrammed into DCOM. To dial-in, there is not setup required.

3.7.1 Modem Dial-out Number Setup

To change modem phone number, first access DCOM user menu. Ref section 3.5.1

Type “c” to access modem menu.

Type “c5/phonenum”, where phonenum is any 50 character string.

Type “e” to save values to non volatile memory

3.7.2 Modem Dial-out number of records sent

To change modem phone number, first access DCOM user menu. Reference Section 3.5.1.

Type “f” to access system functions menu.

Type “c13/num” where num is the number of data records desired to be sent.

3.8 CHANGING FIRMWARE IN THE FIELD VIA MAINTENANCE PORT.

To change firmware in the field, a process has been tailored for a specific terminal program call Procomm Plus 32. To change firmware you must have a laptop or field computer with this software installed. Follow software manufacturer’s installation instructions.

There are several script files which need to be installed for firmware downloading. These files need to reside in certain directories for the process to work correctly.

- Copy the **FLASH.WAX** file to the PC+ Aspect directory (c:\Program Files\Procomm Plus\Aspect).

- Copy **FLASH.KEY, BOOT.S19,** and **TNRCCW2000.MOT** files to the PC+ home directory (c:\Program Files\Procomm Plus).
- Start PC+ , the ProcommPlus Terminal window will appear on the display.

In the Script File fall-down-directory field of the Default Action bar select the '**flash**' script file. As soon as you select the script file it starts running. First sign of the file running is the impressed key and the moving icon of the Start/Stop button in the Default Action bar. At the same time, the row of buttons – Meta Keys – in the lower segment of the Terminal window, changes its appearance from the PC+ default setting to the setting defined by the "flash.key" file.

The Flash.wax Procomm Plus Aspect language script file provides the user interface for the communication with the Flash EPROM module and transfer of ZenoSoft (Zeno firmware) and/or the Boot-Loader software to the Flash EPROM module via direct serial or modem connection.

Figure 3-1 illustrates elements of the Terminal Window which will be used more frequently with the 'FLASH.WAX' script file.

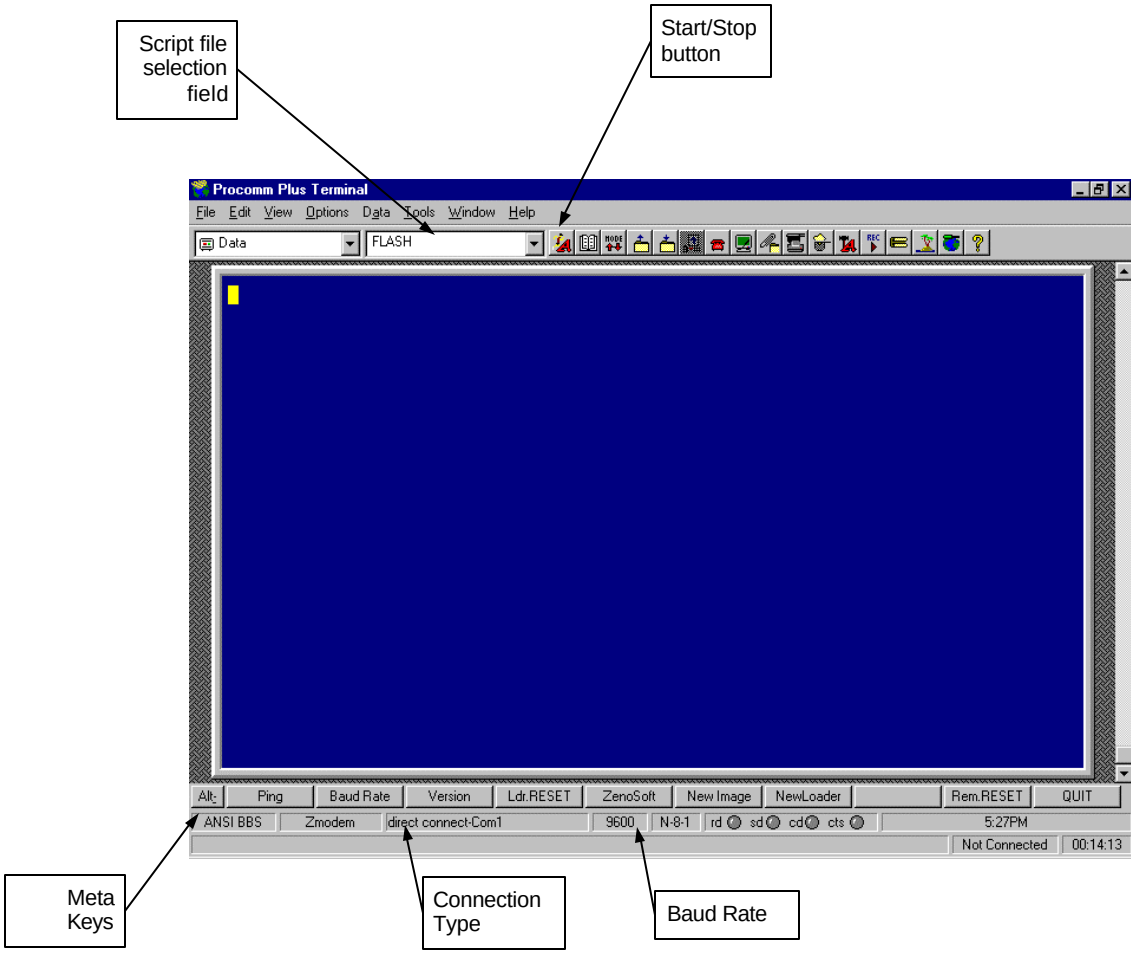

Figure 3-1. FLASH.WAX Terminal Window Example

- Select the type of communication

The script file does not setup the default type of connection, so the user needs to select the type of communication and establish either direct serial or modem communication with Zeno data logger (Remote) before starting the script file.

This selection is made in the Quick Select line – the first line below the Meta Key line. Click in the third field from the left of the Quick Select line and a selection of available connection types will be displayed. Select the appropriate one.

Upon exiting the PC+ session, this selected connection type will be saved and selected as the default connection type for the next PC+ session.

Each Meta Key, when selected, performs a programmed function when the script file is running. The script file, in a case of communication or functional failure, repeats the failed action 3 (three) times before notifying the user of the problem.

Messages transmitted to Remote, and responses received from Remote, are displayed on the PC+ Terminal window to ease the possible troubleshooting. This function is disabled during the file transfer. Descriptions of each metakey are below:

'Ping' Key

Selection of this key initiates test of the communication channel between Host and Remote. This key can be used properly only when Boot-Loader is active – see description for the 'LdrRESET' key.

In all other cases, after three unsuccessful attempts to get a response from Remote, the response from Host will be, "No response from Remote."

'Baud Rate' Key

Selection of this key opens an input dialog box requesting the new baud rate input from the user. Legal input values are: 1200, 4800, 9600, and 19200. Upon selection of the baud rate and an ACK response form Remote, the script file changes the baud rate of the PC+ comport currently in use and displays the new value in the fourth field of the Quick Select line of the PC+ Terminal window.

Currently, 9600 is the only baud rate supported by Boot-Loader.

'Version' Key

Selection of this key returns the software version of Boot-Loader currently in use. This key can be used properly only when Boot-Loader is active – see description for the 'LdrRESET' key.

In all other cases, after three unsuccessful attempts to get a response from Remote, the response from Host will be, "No response from Remote."

'LdrRESET' (Boot-Loader Reset) Key

Selection of this key resets Remote and enables communication with Boot-Loader. The user has 30 (thirty) seconds to enter/send any Boot-Loader command before Boot-Loader times-out and hands the control over to ZenoSoft.

The Boot-Loader timer resets to the next 30 seconds every time a valid command is received.

'ZenoSoft' Key

Selection of this key initiates immediate switch of control from Boot-Loader to ZenoSoft. This key can be used properly only when Boot-Loader is active – see description for the 'LdrRESET' key.

If there is no application software loaded in the Flash EPROM and the user selects the ZenoSoft key, the final response on the terminal display will be (after a 10 second pause), "Command Processing Failed."

'New Image' Key

Selection of this key initiates transfer of a new ZenoSoft S19 formatted file into Flash EPROM. It opens the File Selection dialog and offers a default ".mot" file name. The user should either select a new ".mot" file name or accept the default file name.

When the name is selected the script starts the file transfer one line at the time. To monitor the progress of the file transfer a "*" (star) is displayed on the screen for every 25 (twenty five) successfully transmitted lines.

In a case of a line transfer failure, the script retransmits the line up to 3 (three) times before it notifies the user of the problem.

'New Loader' Key

Selection of this key initiates transfer of a new Boot-Loader S19 formatted file into Flash EPROM. It opens the File Selection dialog and offers a default ".s19" file name. The user should either select a new ".s19" file name or accept the default file name.

When the name is selected the script starts the file transfer one line at the time. To monitor the progress of the file transfer, a "*" (star) is displayed on the screen for every 25 (twenty five) successfully transmitted lines.

In a case of a line transfer failure, the script retransmits the line up to 3 (three) times before it notifies the user of the problem.

Note: Loss of the power during the Boot-Loader file transfer will disable the Flash EPROM. Perform the transfer when the communications and power source are perfectly reliable.

'RemRESET' (Remote Reset) Key

Selection of this key resets Remote and returns control to ZenoSoft. If a copy of ZenoSoft is not available in the Flash EPROM, the script notifies the user with a dialog box: "Command Processing Failed."

'QUIT' Key

Selection of this key stops the execution of the script file. Prior the exit the script file restores the PC+ default set of Meta Keys.

4. OPERATION

Coastal Environmental Systems

FP Upgrade Technical Manual

4.1 GMA

Operator input of sensor notations, the date, time and the display units is very straightforward. Even wearing gloves, it is easy to operate the keypad. There are different top-level menus that are reached by scrolling. The operator scrolls through the different menus by pressing the keys ⇧, ⇩. After a period of time the display will always return to default data display.

4.1.1 Default Data Display

In this display, the ZENO will output the data as specified in the configuration using the new Fischer-Porter Display Process.

Once every 10 seconds, the data that will be displayed is the precipitation data (in inches), temperature (in Fahrenheit) and shaft encoder (feet) in the following format:

```
02/05/01 12:13:10
Rain:        1.01 in
Temp:          56 F
Shaft:     587.56 ft
```

5 seconds later, the data that will be displayed is the 24-hour difference in precipitation, temperature and the shaft encoder:

```
02/05/01 12:13:15
24RainDiff:  5.15 in
Temp:          56 F
Shaft:     587.56 ft
```

If no data is available for a particular field, the display will show "-----" instead of a value.

4.1.2 Entering Sensor Notations

Scroll through until this display shows. In this display, the ZENO will query the user for a 3-digit sensor notation code as follows:

```
New Sensor Notation:
Enter value:
```

The user can then enter a 3-digit number on the keypad, followed by pressing either the ENTER or CANCEL button. If ENTER is pressed and the value is between 0 and 255, it will be accepted, otherwise an "Out of Range" error will be displayed. If CANCEL is pressed, no action will be taken and the value will be cleared from the display.

In this display, the ZENO will query the user for a 3-digit sensor notation code as follows:

```
New Sensor Notation:
Enter value:
```

The user can then enter a 3-digit number on the keypad, followed by pressing either the ENTER or CANCEL button. If ENTER is pressed and the value is between 0 and 255, it will be accepted, otherwise an "Out of Range" error will be displayed. If CANCEL is pressed, no action will be taken and the value will be cleared from the display.

4.1.3 Date & Time Display

Scroll through until this display shows. In this display, the ZENO will display its current date and time. The user will have the option to change the current date and time stored in the ZENO:

```
Current Date & Time:
02/01/20 14:31:42
New Date & Time:
```

The user can enter a new date & time by typing the numbers only for the new date and time in the sequence "YYMMDDhhmmss". The ZENO will display each number as it is entered and add the appropriate punctuation and delimiters as required. The user can press CANCEL at any time to discontinue entering a new date & time. If the user presses ENTER with an incorrect date time, the ZENO will report an error message and return to the screen. If the new date & time are valid, they will be accepted and the screen will be updated accordingly.

4.1.4 Units Selection Display

Units will be selectable in the following way:

- Rain: inches or millimeters.
- Temperature: degrees Fahrenheit, Celsius, Kelvin or Rankine.
- Shaft Encoder: feet or bits.

Resolution will be selectable in the following way:

- Rain: not selectable.
- Temperature: whole degrees or tenths of degrees.
- Shaft Encoder: whole feet, tenths or hundredths of feet.

Scroll through until this display shows. The display will appear as follows:

```
Current Units:
Rain:  Inches
Temp:  Fahrenheit
Shaft: Feet
```

If the operator wants to change the units, he must press the MODIFY button. Doing so will alter the display as follows:

```
Modify Temp.  Units:
1=Fahr.  2=Celsius
3=Kelvin 4=Rankine
Select:
```

If the user only presses ENTER, nothing will change and the display will go to the next page for resolution. If the user presses CANCEL, it will return to the previous page. If the user enters a valid number followed by ENTER, the new units will be selected and the next page will be displayed. If an invalid number is entered, an error message will be displayed before returning to this page.

The next page will appear as follows:

```
Temp.  Resolution:
0=Whole   1=Tenths
Select:
```

If the user only presses ENTER, nothing will change and the display will go to the next page. If the user presses CANCEL, it will return to the original units page. If the user enters a valid number followed by ENTER, the new resolution will be selected and the next page will be displayed. If an invalid number is entered, an error message will be displayed before returning to this page.

The next page will be for the shaft encoder:

```
Modify Shaft Units:
1=Feet   2=Bits
Select:
```

If the user only presses ENTER, nothing will change and the display will go to the next page for resolution. If the user presses CANCEL, it will return to the previous page. If the user enters a valid number followed by ENTER, the new units will be selected and the next page will be displayed. If an invalid number is entered, an error message will be displayed before returning to this page.

The next page will appear as follows only if Feet were selected as the units:

```
Shaft Resolution:
0=Whole   1=Tenths
2=Hundredths
Select:
```

If the user only presses ENTER, nothing will change and the display will go to the next page. If the user presses CANCEL, it will return to the original units page. If the user enters a valid number followed by ENTER, the new resolution will be selected and the next page will be displayed. If an invalid number is entered, an error message will be displayed before returning to this page.

4.1.5 Data Retrieval Using the DataKey

Data are retrieved every 30 days using the DataKey. To retrieve data, open the enclosure door, insert the DataKey into the key receptacle located on the ZENO GMA interface board. The key cannot be improperly inserted. Follow the prompts that will appear on the ZENO GMA display Remove key when prompted.

For viewing the key data, a CES Datakey reader and software must be used. See Section 4.3 for information.

4.1.6 Retrieving Data Via Maintenance Port

Connect a laptop computer as described in section 3.3.1.

Type “d” <enter> to access ZENO data retrieval menu

Type “*” to display all ZENO data records.

4.2 DCOM

DCOM operation consists of semi-automated sending out of data via phone modem, dialing into phone modem of DCOM, and communicating via radio link to GMA.

4.2.1 Sending Data

To send data via phone modem, simply press the send data. The preprogrammed phone number will be dialed, and a preprogrammed number of data records will be send. The display will indicate the status of the data transfer over a telephone modem. Upon completion, the display will return to its default screen.

4.2.2 Retrieving Data Via the Dial Up Modem

To retrieve data via maintenance port, first access the user menu as specified in section 3.5.1.2. Then type “d’ to access data retrieval menu.

The data set is too expansive to list here, but the following commands are available for retrieving data as shown in Table 4-1. See the ZENO Manual for further discussion.

DATA RETRIEVAL MENU	
(A) Show Records AFTER Specified Time	(C) Compute Data Logging Capacity
(B) Show Records BETWEEN Time span	(D) Delete All Data Records
(Ln) Show LAST n Records	(N) Number Of Records Logged
(*)Show ALL Data Records	(U) User Menu
(@n) Show n Unmarked Records	(Q) Quit
(M) Mark Recently Shown Data	(H) Help
Precede Any "Show Data" Command With An 'X' For X-Modem Transfer (E.g. Enter 'X*' To Send All Data Sets Via X-Modem)	

Table 4-1. ZENO®-3200 data retrieval menu for dial in user

4.2.3 Data Retrieval Via Maintenance Port

To retrieve data via maintenance port, first access the user menu as specified in Section 3.5.1.1.

After accessing the user menu, type “d” to access data retrieval menu. See Table 4-1 for descriptions of retrieval options.

4.3 KEY READER

The Key Reader interfaces directly to a PC. Please refer to the key reader manual for complete set-up instructions. The software is menu driven and guides the user through the download process to download the data from the DataKey. The user may save the data as a comma separated variable (CSV) text file.

Inserting a datakey into the reader will highlight the “key detected” button in Step 1. Download process continues automatically until Step 4. Step 4 prompts to save data to file name shown in list box. To save click mouse pointer on save to file. Clicking on erase key will erase the data on the key. If erasing the key is not desired, simply remove key from keyreader. Software will un-highlight “key detected button.”

Viewing file data at the Step 4 level opens a notepad window similar to that shown in Figure 4-1. Formats associated with the data are explained in the keyreader manual.

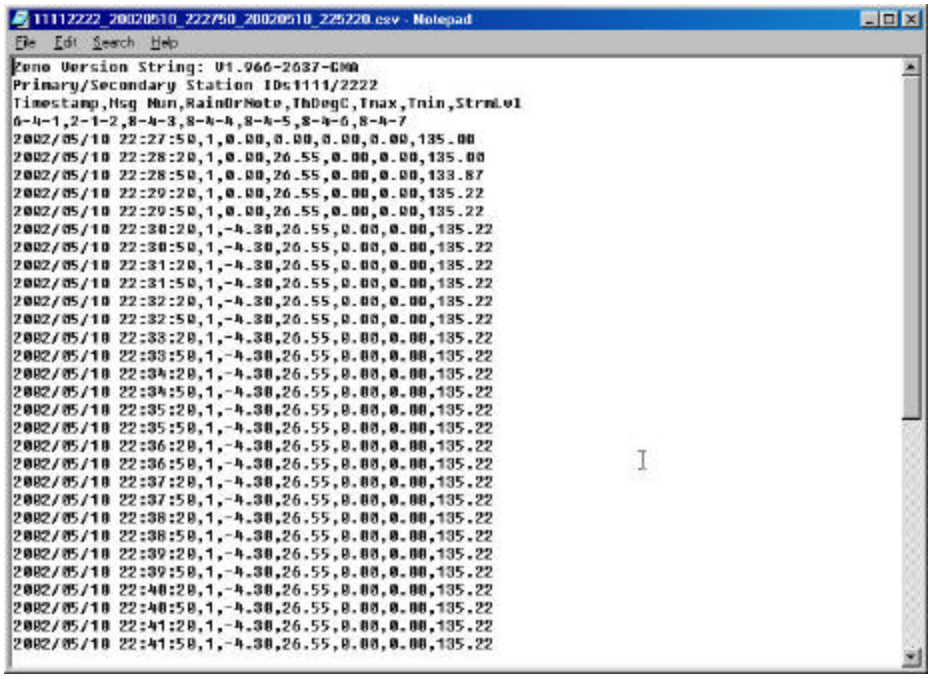

Figure 4-1. Notepad Window of Datakey Reader

5. MAINTENANCE

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5.1 PREVENTATIVE MAINTENANCE PROCEDURES

- Check physical condition of equipment.
- Inspect all mounting hardware and tighten fasteners as required.
- Inspect condition of surface cables and connectors for signs of wear or damage.
- Inspect Enclosure for signs of damage or corrosion between the ZENO GMA and enclosure.
- Remove and replace any damaged equipment.
- Inspect condition of humidity indicator on ZENO GMA.
- If the indicator is bright pink, remove and replace the ZENO GMA.
- Calibration check of load cell assembly. Follow calibration procedures (section 3.1). If not properly calibrated, adjust load cell calibration coefficients following ZENO GMA set up procedure in section 3.3.
- Inspect flexures per NWS procedures
- Clean ZENO GMA display
- Clean ZENO DCOM display (if present)

5.2 SYSTEM SELF TESTS

Both the ZENO GMA and the ZENO DCOM have extensive built-in self-tests. The ZENO®-3200 in the GMA has many self- tests dedicated to the operation of the sensors as well as self-tests relating to its own operation. Likewise the ZENO DCOM has considerable test and fault tolerant built-in features to bolster communication abilities and track the status of the communication devices and their relative operation.

5.2.1 GMA self-tests

Hardware and software self-tests carried out by the ZENO GMA are as follows:

- **Analog input Zero-offset reading:** This test verifies the operation of the analog input channels as well as the A/D converter by periodically setting the analog input channels to ground. Successive measurements are then made at all gain/attenuation settings to determine the amount of ground reference noise present in the system. Failure of this self-test is manifested in out of bound or anomalous analog sensor values. If a failure occurs, remove and replace the Zeno GMA as described in Section 5.3.2.4.
- **EEPROM Read/Write status:** All reads and writes to the EEPROM are verified when performed. Read operations are verified by first scanning the entire contents of the EEPROM, next calculating a checksum, and finally comparing the calculated checksum to the checksum value read from the EEPROM itself. EEPROM write operations are immediately followed by a read verification and checksum recalculation. This test guards against flipped bits due to power surges or component failure. Failure of this self-test is manifested in an "Unsuccessful EEPROM program" message displayed to the technician when performing this function. If the failure message appears after three verification attempts, remove and replace the Zeno GMA as described in Section 5.3.2.4.
- **Logging-memory status:** On system start-up, a memory location is read to look for a signature of existing logged data memory records. If the proper sequence of data is not found then the system assumes a memory chip power-loss has occurred or that this is the system's very first start-up sequence. In either case the data logging memory is initialized. Failure of this self-test is manifested in loss of data after power-up while system operational. If a failure occurs, remove and replace the Zeno GMA as described in Section 5.3.2.4.
- **System power:** The GMA monitors the external voltage by two methods: 1) by measuring the voltage with the 12-bit A/D and 2) by a power-fail interrupt signal generated by the system supervisory chip (U3, MAX691 watchdog chip). If the external voltage falls below the threshold, the system is held in a low-power reset state. Failure of this self-test is manifested in the system not operating due to low power reset state. If a failure occurs, remove and replace the Zeno GMA as described in Section 5.3.2.4.
- **Internal temperature:** The GMA has an internal temperature-sensing device, which is periodically read to monitor the internal temperature condition. This value is used to monitor internal temperature and does not generate alarms or other notification.

5.2.2 DCOM Self Tests

The DCOM runs a sub-set of the system tests performed by the ZENO®-3200 (GMA). These are:

- **EEPROM Read/Write status:** All reads and writes to the EEPROM are verified when performed. Read operations are verified by first scanning the entire contents of the EEPROM, next calculating a checksum, and finally comparing the calculated checksum to the checksum value read from the EEPROM itself. EEPROM write operations are immediately followed by a read verification and checksum recalculation. This test guards

against flipped bits due to power surges or component failure. Failure of this self-test is manifested in an "Unsuccessful EEPROM program" message displayed to the technician when performing this function. If the failure message appears after three verification attempts, remove and replace the DCOM as described in Section 5.3.2.14.

- **System power:** The DCOM monitors the external voltage by two methods: 1) by measuring the voltage with the 12-bit A/D and 2) by a power-fail interrupt signal generated by the system supervisory chip (U3, MAX691 watchdog chip). If the external voltage falls below the threshold, the system is held in a low-power reset state. Failure of this self-test is manifested in the system not operating due to low power reset state. If a failure occurs, remove and replace the Zeno DCOM as described in Section 5.3.2.4.
- **Internal temperature:** The DCOM has an internal temperature-sensing device, which is periodically read to monitor the internal temperature condition. This value is used to monitor internal temperature and does not generate alarms or other notification.

5.2.3 Hardware and Software Watchdog Timers in BOTH the GMA and DCOM

Both the GMA and the DCOM have a hardware and software watchdog timer. The hardware watchdog timer is on the surface-mount board. It is possible, as with all remote electronic systems, that large electrical surges from excessive RFI or lightning will scramble the software in the RAM. The function of the hardware watchdog timer is to test that the device is functioning, on a regular basis. If it observes an error in the operation, the hardware watchdog timer restarts the system. The GMA/DCOM is rebooted using the protected stored code in EPROM and the protected settings in EEPROM to reboot.

The software watchdog timer functions in a different manner. Each software task reports periodically to a central task mailbox. If a message is not received from each software task within a specified (task-dependent) period, the software watchdog timer system resets itself automatically. Thus, if external interference has caused the GMA/DCOM to operate in error, but still operate (therefore not alerting the hardware watchdog timer), the software watchdog will correct the system. Normal operation starts in less than 30 seconds of the timeout.

5.3 CORRECTIVE MAINTENANCE

5.3.1 Fault Isolation and Troubleshooting

5.3.1.1 ZENO DCOM Display not Illuminated

Verify that there is local AC power and that the ZENO-DCOM is plugged into an AC outlet. Three fault conditions that can create the symptom: blown fuse in the ZENO DCOM power cord outlet, faulty AC power cord, or faulty ZENO DCOM. Follow the troubleshooting flowchart in Figure 5-1.

Equipment Needed

Spare fuses

Spare AC power cord

Spare ZENO DCOM

Tools Needed

A flat bladed screwdriver is needed to open fuse holder on the back of the ZENO DCOM

Laptop computer

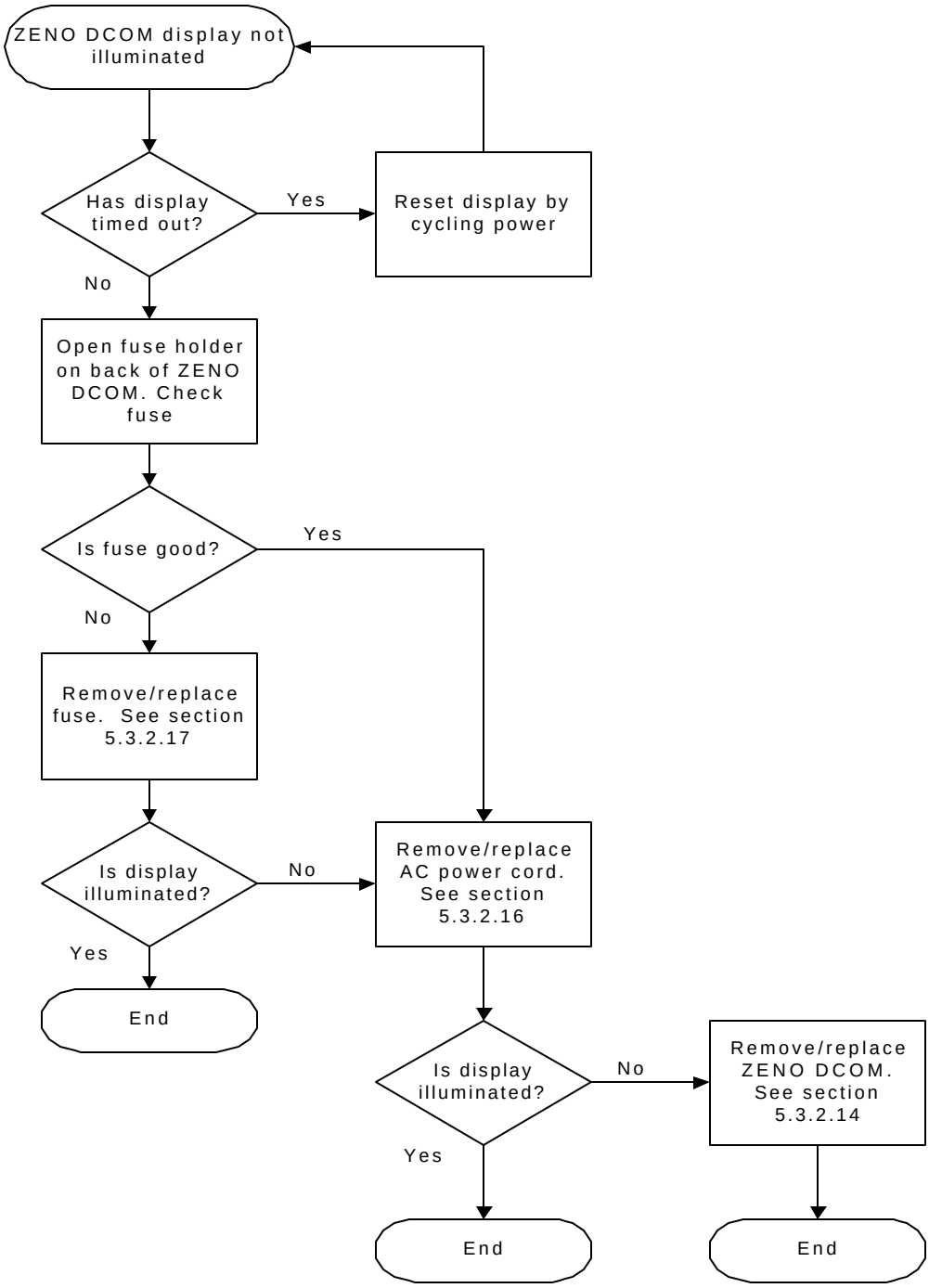

Figure 5-1. ZENO DCOM Display not Illuminated

5.3.1.2 ZENO DCOM Display Illuminated, No Data Reported

This condition may be caused by loss of data into ZENO GMA, failure of the ZENO GMA, failure of the radio path between the ZENO GMA and ZENO DCOM, or a faulty ZENO DCOM.

Verify that DCOM antenna and GMA antennas are aligned properly and that there is nothing obstructing the line of sight between the DCOM antenna and GMA antenna (500 yards requires line of sight, shorter distances may not require line of sight)

Verify that all sensor cables are connected to the ZENO GMA and that all cables are in good physical condition (i.e., they have not been cut or damaged)

Push “ENTER” key on ZENO GMA keypad to verify that the ZENO GMA is displaying data. If the ZENO GMA display is not illuminated, go to section 5.3.1.4 to troubleshoot the ZENO GMA. If the ZENO GMA is displaying data, check the radio path between the ZENO GMA and ZENO DCOM. Follow the troubleshooting flowchart in Figure 5-1.

Equipment Needed

Two spare antennas

Spare ZENO DCOM

Spare ZENO GMA

Tools Needed

Phillips screw driver

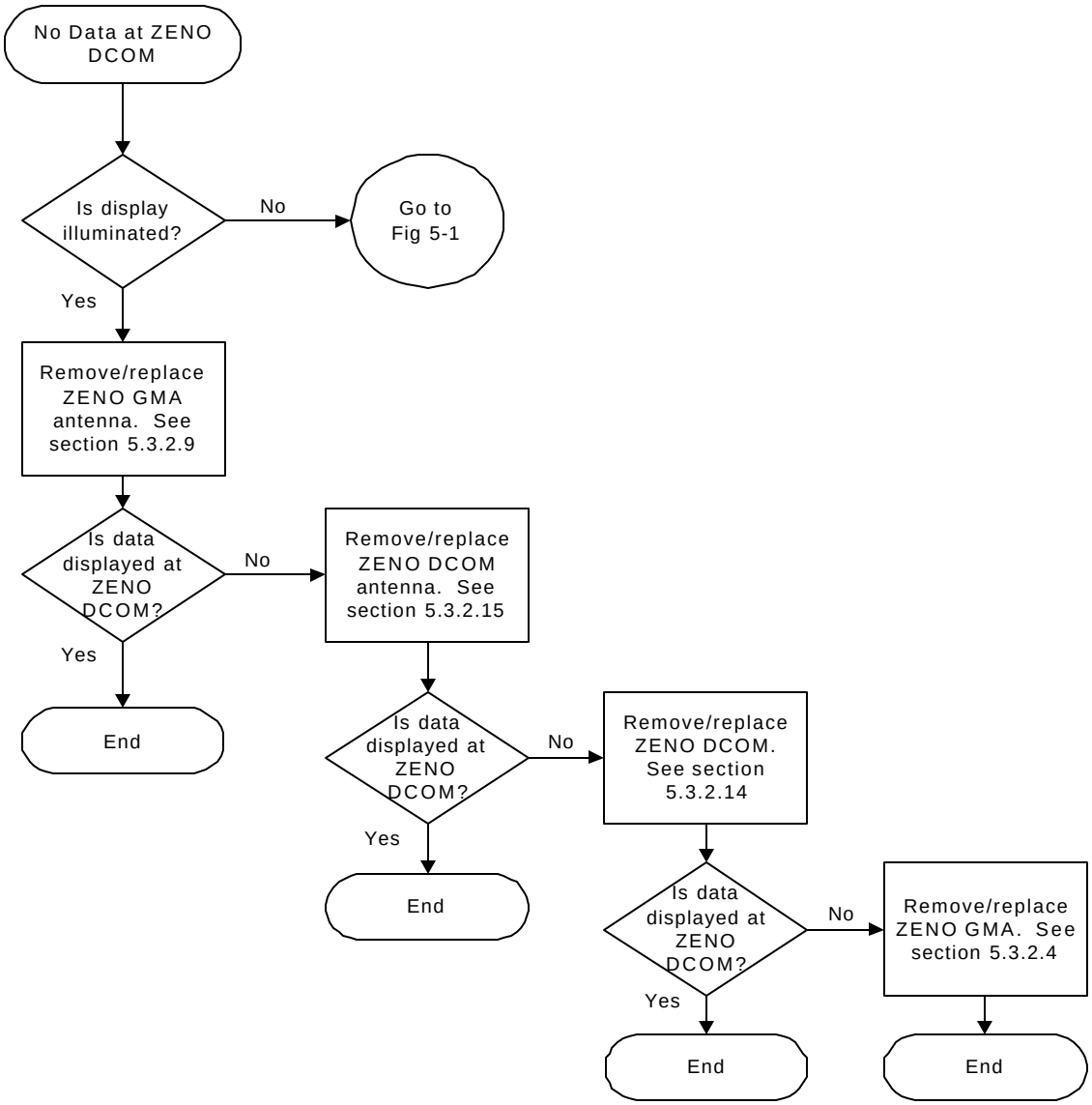

Figure 5-1. ZENO DCOM Display Illuminated, No Data Reported

5.3.1.3 Failure to Communicate via Telephone

If the ZENO DCOM fails to communicate via telephone line, the problem may be caused by a faulty telephone jack, faulty telephone cable or faulty ZENO DCOM. Using a good telephone or telephone test equipment, verify that the telephone jack is working. Follow the troubleshooting flowchart in Figure 5-1.

Equipment Needed

Spare telephone cable

Spare DCOM

Tools Needed

None

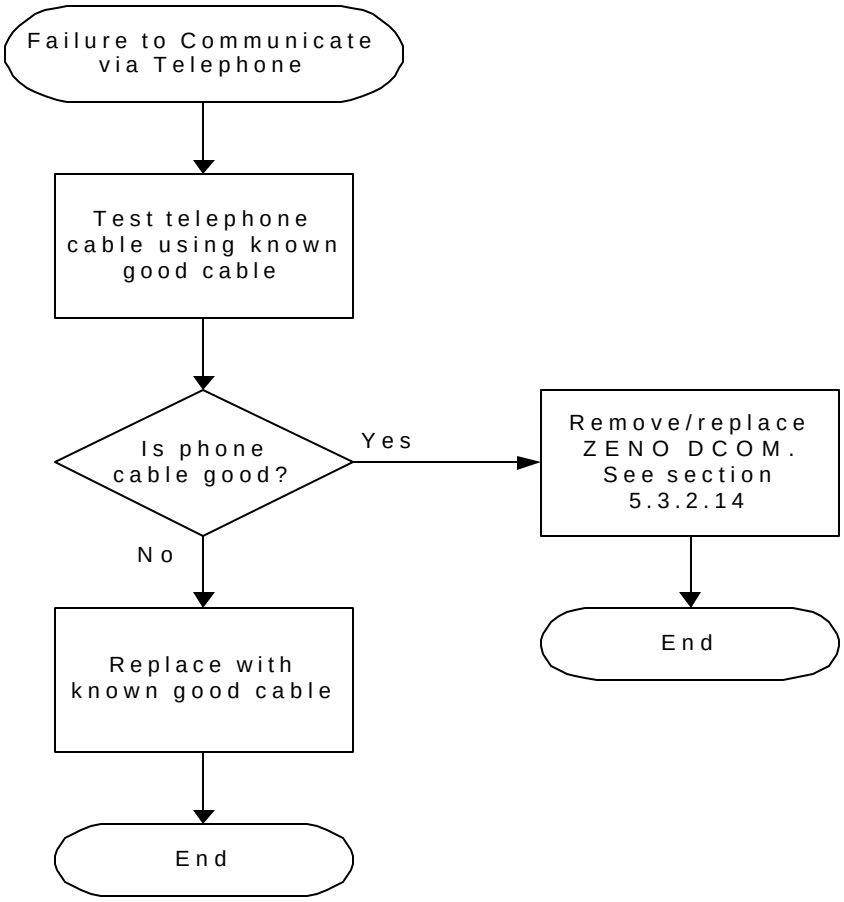

Figure 5-1. Failure to Communicate via Telephone

5.3.1.4 No Display at GMA

Five fault conditions can result in the symptom: Blown fuse in Battery Charger PCA, faulty battery, faulty battery cable, faulty battery charger PCA, or faulty GMA. Before starting troubleshooting procedures, disconnect solar panel cable. Follow the troubleshooting flowchart in Figure 5-1.

Equipment Needed

Spare battery

Spare fuses

Spare battery charger PCA

Spare battery cable

Spare GMA

Tools Needed

Flashlight

½” Wrench

Voltmeter

A flat blade screwdriver

Phillips screwdriver

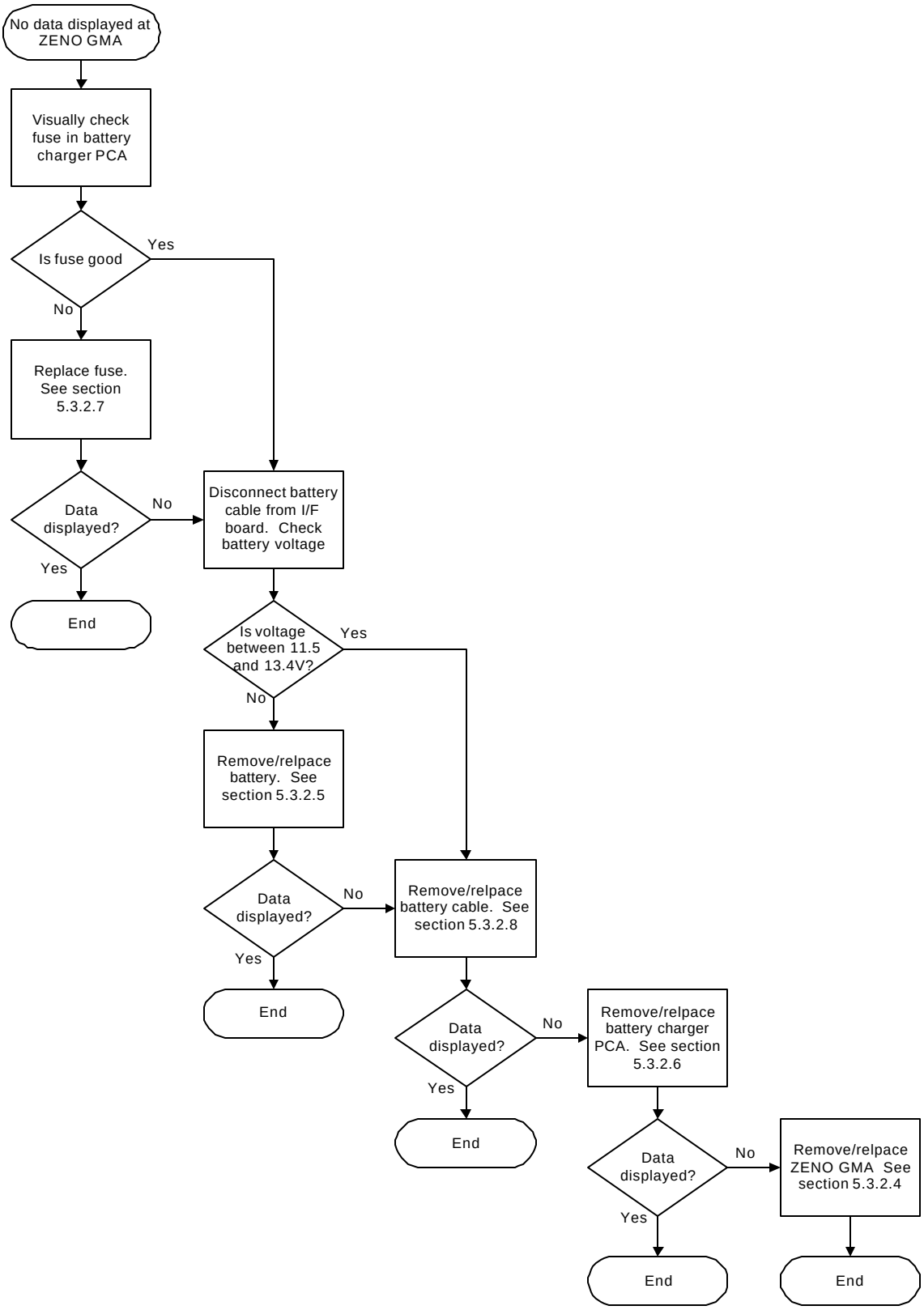

Figure 5-1. No Display at ZENO GMA

5.3.1.5 Missing, Out of Range, or No Change in Precipitation Sensor Data

These conditions may be caused by a faulty load cell cable, including connector failure; faulty ZENO GMA, including connector failure or failure of the load cell assembly. Follow the troubleshooting flowchart in Figure 5-1.

Equipment Needed

Spare load cell cable

Spare load cell assembly

Spare GMA

Calibration weights

Tools Needed

Adjustable wrench

Adjustable wrench

Ohm meter

3/64 allen wrench

Calibration weights

CAUTION

Use care when handling the load cell assembly. Do not scratch the surface of the load cell.

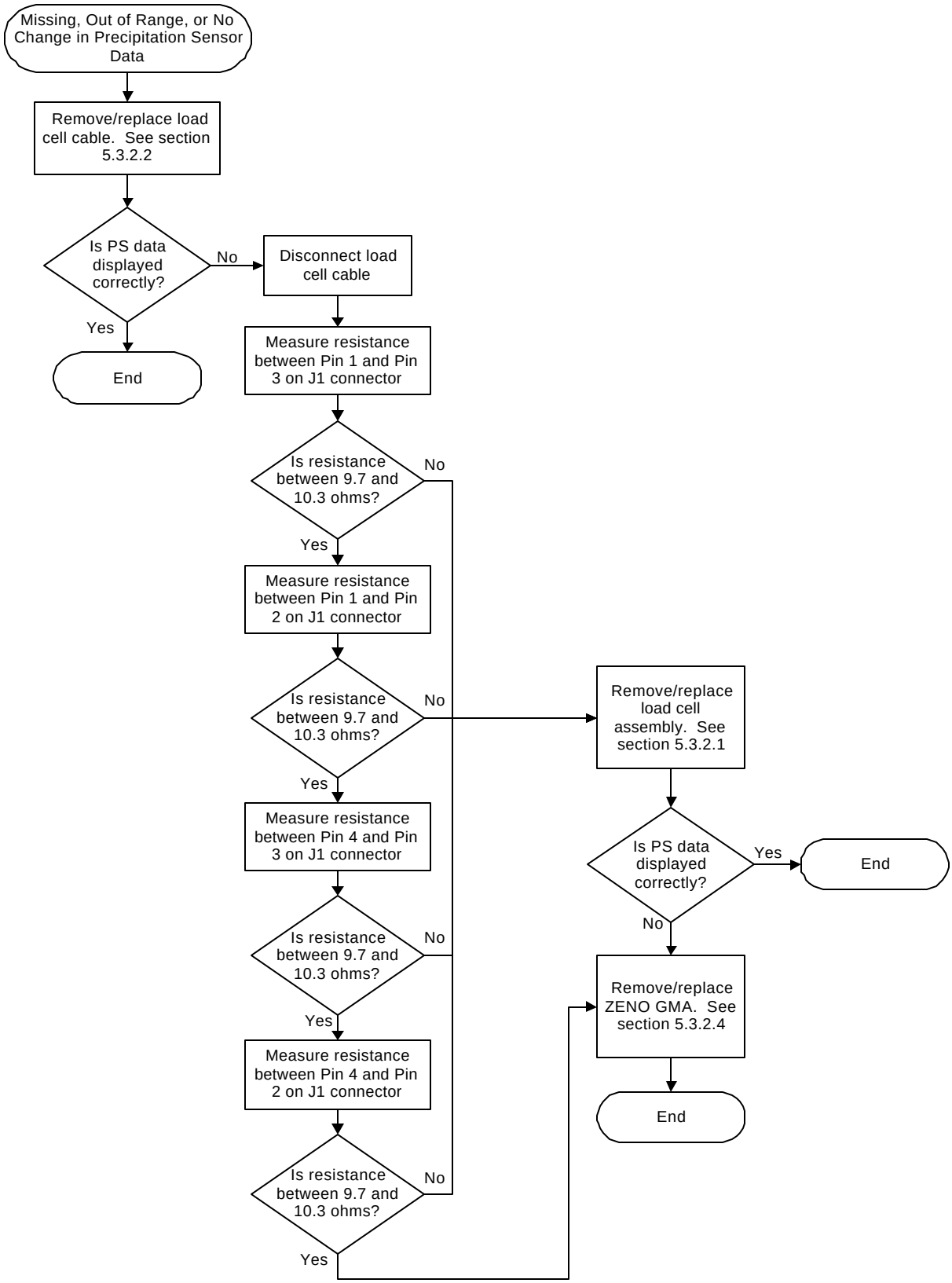

Figure 5-1. Missing, Out of Range or No Change in Precipitation Sensor Data

5.3.1.6 Missing, Out of Range or No Change in Shaft Encoder Data

These conditions may be caused by a faulty shaft encoder, faulty shaft encoder cable, or faulty ZENO GMA. Follow the troubleshooting flowchart in Figure 5-1.

Equipment Needed

Spare shaft encoder

Spare shaft encoder cable

Spare GMA

NWS procedures for troubleshooting, removing and replacing the shaft encoder

Tools Needed

Tools per NWS shaft encoder procedure

Phillips screw driver

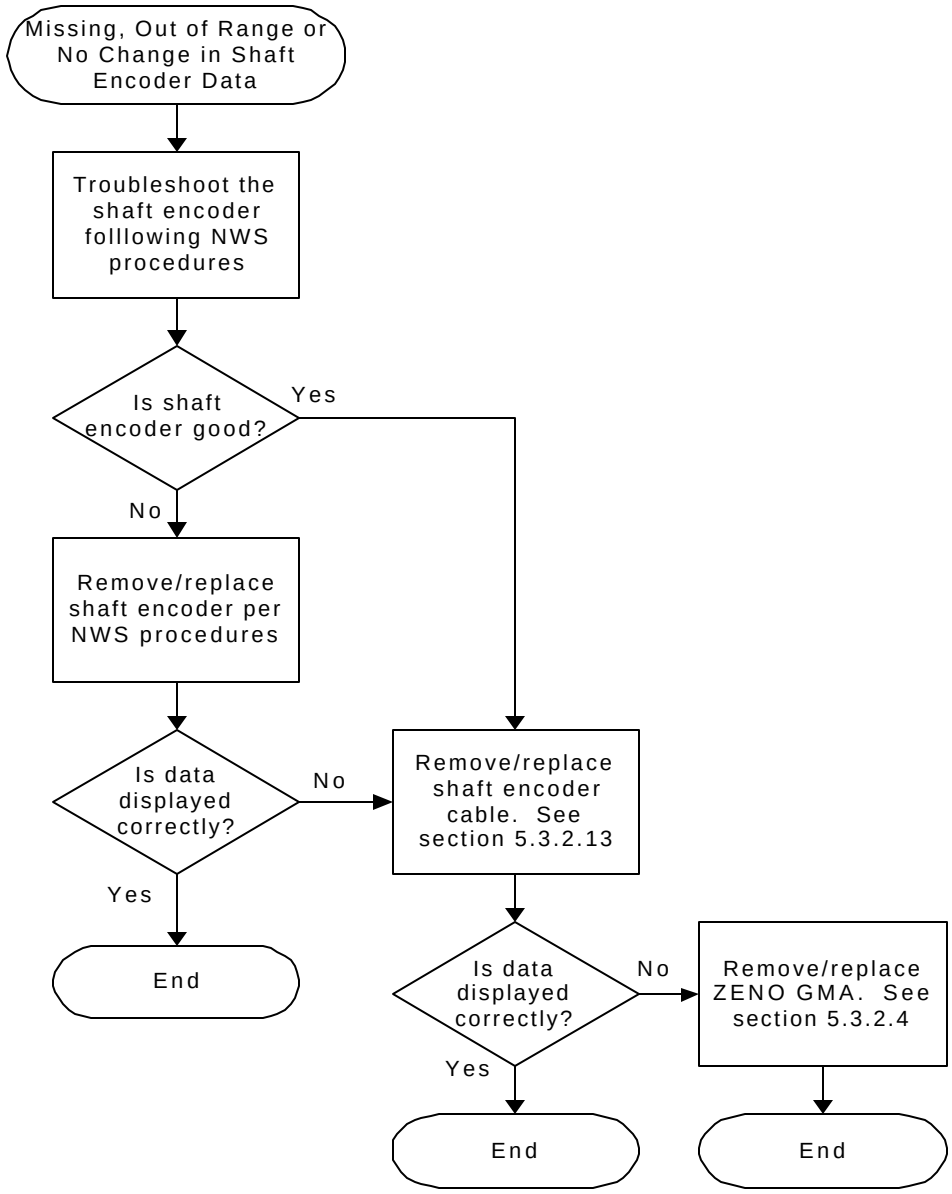

Figure 5-1. Missing, Out of Range or No Change in Shaft Encoder Data

5.3.1.7 Missing, Out of Range or No Change in Thermistor Data

These conditions may be the result of a faulty thermistor, faulty thermistor cable, or faulty ZENO GMA. Follow the troubleshooting flowchart in Figure 5-1.

Equipment Needed

Spare thermistor/shelter assembly

Spate thermistor cable

Spare GMA

NWS procedures for troubleshooting, removing and replacing the shaft encoder

Tools Needed

Tools per NWS thermistor troubleshooting procedure

Phillips screw driver

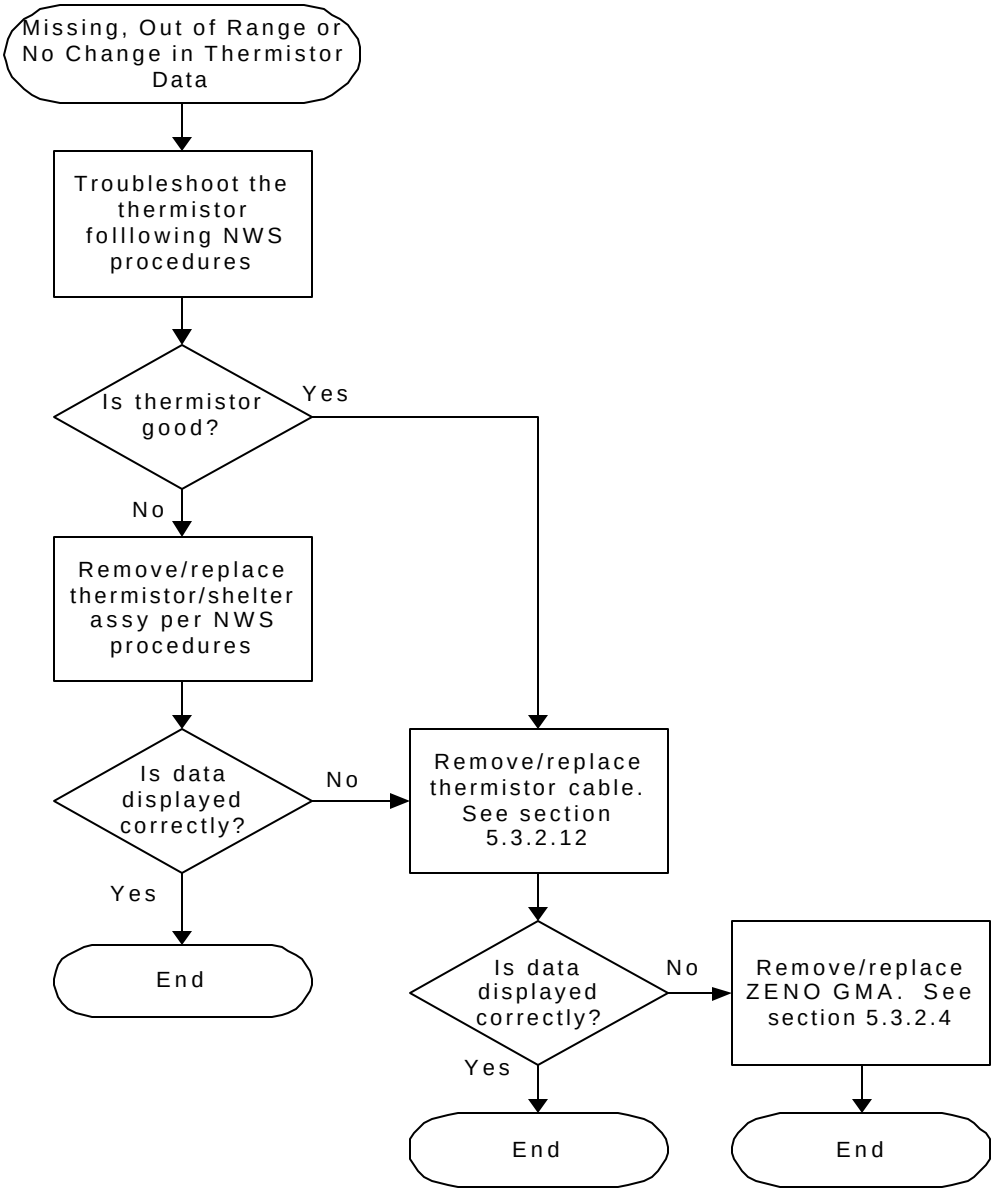

Figure 5-1. Missing, Out of Range or No Change in Thermistor Data

5.3.1.8 Frequent Battery Replacement

Frequent battery replacement is defined as replacing the battery more than once every 6 months, except in the case of vandalism. Frequent battery replacement may be due to a failure to properly charge the battery, either through the solar panel or the AC Battery Charger, failure of the Battery Charger PCA or Battery Charger PCA Fuse, or it may be a faulty battery. Follow the troubleshooting flowchart in Figure 5-1.

Equipment Needed

Spare battery

Spare fuses

Spare Battery Charger PCA

Spare AC battery charger

Spare solar panel

Spare solar panel cable

Solar panel mounting hardware

Tools Needed

½" Wrench

Voltmeter

A flat blade screwdriver

Small Phillips screwdriver

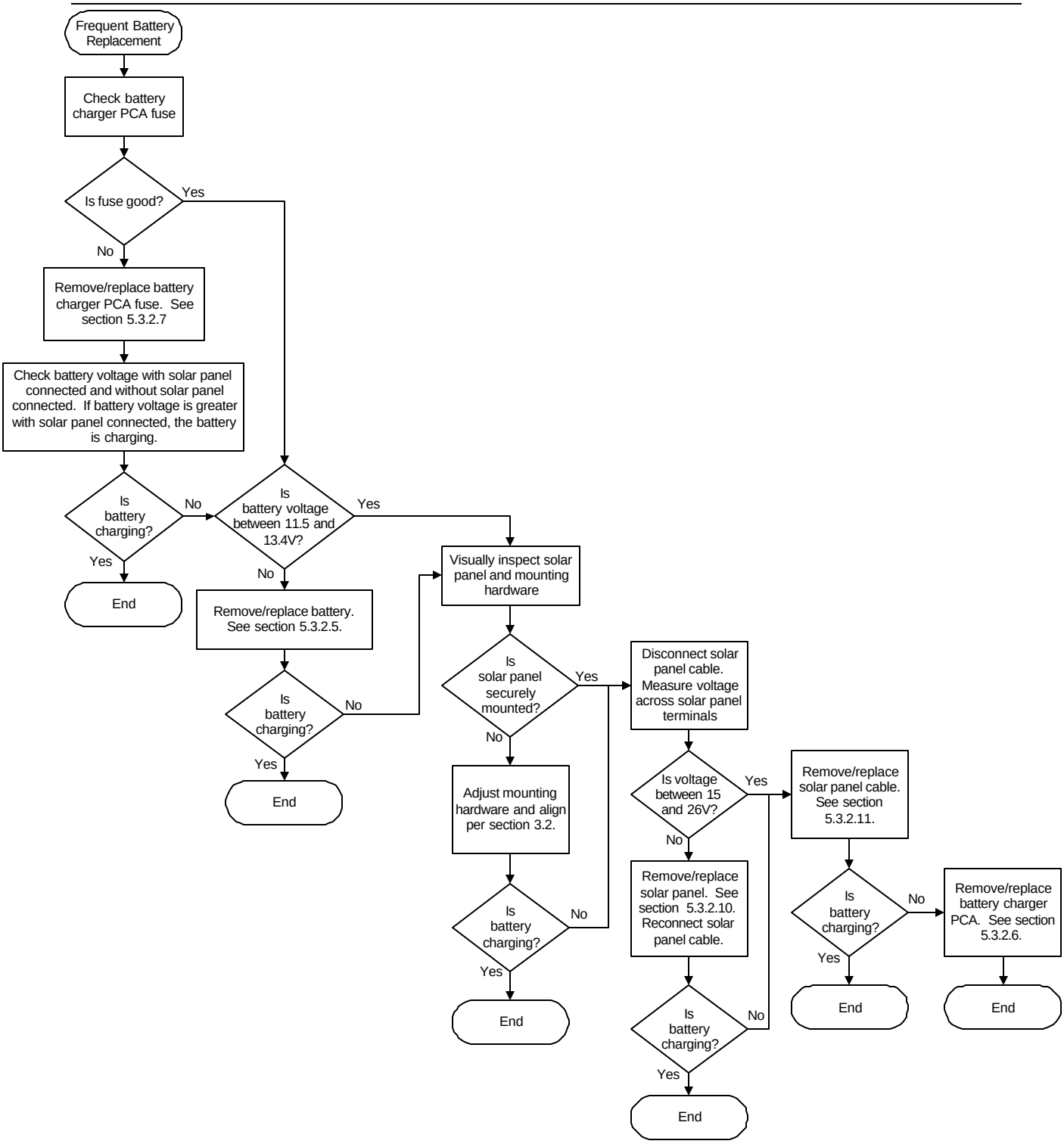

Figure 5-1. Frequent Battery Replacement

5.3.1.9 ZENO GMA Keypad not Working

Equipment Needed

Spare ZENO GMA

Tools Needed

Phillips screw driver

Laptop computer

Straight through DB9M to DB9F cable

If the ZENO GMA keypad is not working, the ZENO GMA is faulty. Remove/replace the ZENO GMA according to procedures in section 5.3.2.4.

5.3.1.10 ZENO DCOM Pushbutton not Working

Equipment Needed

Spare ZENO DCOM

Tools Needed

Laptop computer

Straight through DB9M to DB9F cable

If the ZENO DCOM pushbutton is not working, the ZENO DCOM is faulty. Remove/replace the ZENO DCOM following procedures in section 5.3.2.14.

5.3.1.11 ZENO GMA Shows Incoherent Characters

Equipment Needed

Spare ZENO GMA

Tools Needed

Phillips screw driver

Laptop computer

Straight through DB9M to DB9F cable

If the ZENO GMA displays incoherent characters, the ZENO GMA is faulty. Remove/replace the ZENO GMA according to procedures in section 5.3.2.4.

5.3.1.12 ZENO DCOM Shows Incoherent Characters

Equipment Needed

Spare ZENO DCOM

Tools Needed

Laptop computer

Straight through DB9M to DB9F cable

If the ZENO DCOM shows incoherent characters, the ZENO DCOM is faulty. Remove/replace the ZENO DCOM according to procedures in section 5.3.2.14.

5.3.1.13 Data Cannot be Retrieved from Data Key

If data cannot be retrieved from the Data Key, it may be due to a faulty key reader, faulty DataKey or faulty ZENO GMA. Follow the troubleshooting flowchart in Figure 5-1.

Equipment Needed

Spare key reader

DataKey with known good data

Spare ZENO GMA

Tools Needed

PC

Phillips screwdriver

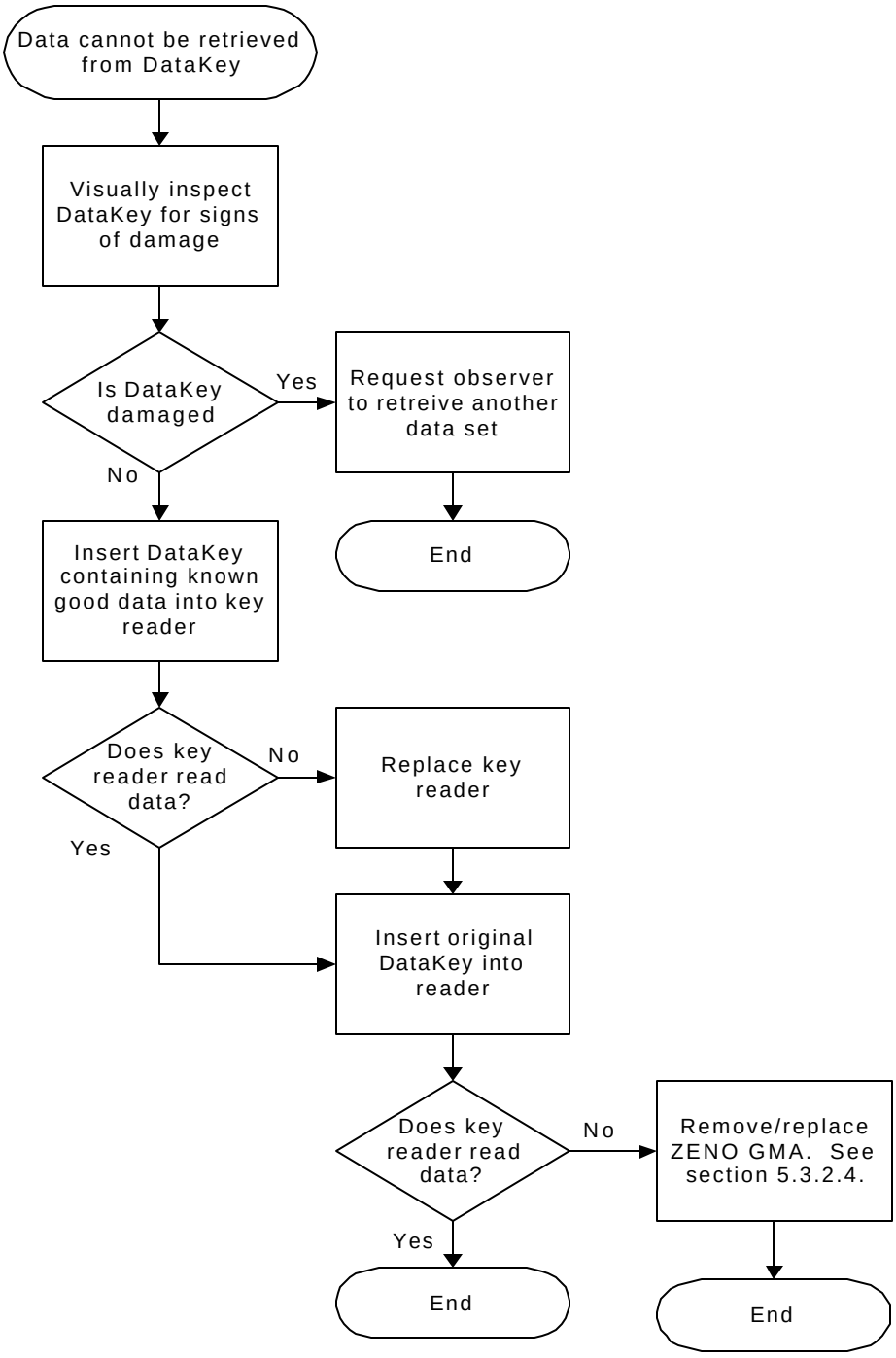

Figure 5-1. Data Cannot be Retrieved from DataKey

5.3.1.14 GMA Displaying Wrong Time/Date

The date/time stamp displayed on the GMA is established from an internal real time clock (RTC). The RTC has a 10-year lithium battery source, which is independent of the system backup battery. This allows the RTC to keep time even if all external power is removed. The clock is calibrated to give an accuracy of 30 seconds per month (2 PPM). However, if either the

clock or the clock battery fails, the GMA display time and date will begin to deteriorate. This will be most readily noticed if the GMA is shut down and restarted, in that a completely wrong date/time will be displayed. If this occurs, remove and replace the Zeno GMA as per Section 5.3.2.4.

5.3.1.15 DCOM Displaying Wrong Time/Date

The date/time stamp displayed on the DCOM is established from an internal real time clock (RTC). The RTC has a 10-year lithium battery source, which is independent of the system backup battery. This allows the RTC to keep time even if all external power is removed. The clock is calibrated to give an accuracy of 30 seconds per month (2 PPM). However, if either the clock or the clock battery fails, the DCOM display time and date will begin to deteriorate. This will be most readily noticed if the DCOM is shut down and restarted, in that a completely wrong date/time will be displayed. If this occurs, remove and replace the DCOM as per Section 5.3.2.14.

5.3.2 Remove/Replace Procedures

Once the faulty LRU is identified, the LRU should be removed, replaced with a new LRU, and faulty LRU returned to the Depot to be repaired or scrapped.

5.3.2.1 Load Cell Assembly

Tools required: Allen wrench

CAUTION

Use care when handling the load cell assembly. Do not scratch the surface of the load cell.

NOTE

Precipitation data will not be collected while replacing the load cell assembly

- Remove hood of the FP gauge
- Drain bucket of any fluids.
- Remove bucket and lower shell.
- Adjust the stop to support the weight
- Disconnect the internal load cell cable from the load cell PCB.
- Remove the four 4-40 socket head bolts holding the load cell assembly.
- Remove the load cell assembly.
- Replace the load cell assembly with a new load cell assembly.
- Install the four 4-40 socket head bolts.
- Finger tighten the 4 socket head bolts using the allen wrench.
- Reconnect the internal load cell cable to load cell PCB.

- Check Load Cell reading.
- Perform Load Cell Calibration following calibration procedures provided in section 3.1
- If new calibration constants are required, enter the new calibration constants into the ZENO GMA following the ZENO GMA setup procedures in section 3.3
- Replace lower shell, bucket and hood of the FP gauge

5.3.2.2 Load Cell Cable

Tools required: Adjustable wrench

NOTE

If load cell cable is buried, excavate cable before beginning replacement

NOTE

Precipitation data will not be collected while replacing the load cell cable

- Disconnect the Load Cell Cable and strain relief from the FP gauge
- Disconnect the Load Cell Cable from the GMA System Enclosure
- Connect the new Load Cell Cable to the GMA System Enclosure
- Connect the new Load Cell Cable and strain relief to the FP gauge
- Check Load Cell reading.
- No further checkout is needed.

5.3.2.3 GMA Enclosure

Tools required: Phillips screwdriver, 9/16” socket wrench

NOTE

Data will not be collected while replacing the GMA Enclosure

- Disconnect all cables from the ZENO GMA Assembly.
- If present, disconnect the antenna from the ZENO GMA Assembly.
- Open the enclosure door.
- Disconnect the battery cable from the ZENO GMA Interface Board.
- Remove the battery from the enclosure.
- Using the Phillips screwdriver, remove the 3 screws and star washers holding the ZENO GMA Assembly to the Enclosure.
- Slide the ZENO GMA Assembly forward and lift out of the system enclosure.
- Using the 9/16” socket wrench, remove the lower U-bolt holding the enclosure to the pole.

- Lift the enclosure from the pole hook
- Replace the enclosure
- Secure the enclosure to the pole by replacing the lower U-bolt.
- Return the ZENO GMA to the enclosure
- Secure the ZENO GMA to the enclosure using the 3 screws and star washers
- Reconnect all cables and antenna (if present)
- Return battery to enclosure and reconnect battery cable to ZENO GMA Interface Board
- No checkout procedures are required when replacing the enclosure

5.3.2.4 ZENO GMA Assembly

Tools required: Phillips screwdriver

NOTE

Data will not be collected while replacing the ZENO GMA. Site specific information must be entered following replacement.

- Disconnect all cables from the ZENO GMA Assembly.
- If present, disconnect the antenna from the ZENO GMA Assembly.
- Open the enclosure door.
- Disconnect the battery cable from the ZENO GMA Interface Board.
- Using Phillips screwdriver, remove the 3 screws and star washers holding the ZENO GMA to the system enclosure
- Slide the ZENO GMA forward and lift out of the system enclosure.
- Replace the ZENO GMA
- Secure the ZENO GMA to the enclosure using the 3 screws and star washers
- Connect the antenna (if present)
- Connect all external cables
- Connect the battery cable to the ZENO GMA Interface Board
- Confirm that the ZENO GMA display is illuminated
- Follow setup procedures in section 3.3 to enter sensor calibration data and other site specific information
- Using the keypad, enter date and time and any other notations
- Close GMA enclosure

5.3.2.5 Battery

Tools required: ½" wrench

NOTE

If the system is equipped with an EEv enclosure, the battery will be located in the EEv enclosure. If buried, excavate the EEv enclosure to access the battery.

NOTE

Data will not be collected while replacing the battery

- Open the GMA enclosure or EEv enclosure
- Remove terminal covers
- Using the ½" wrench, disconnect the battery cable from the 12V battery. Remove black (-) lead first.
- Remove the battery
- Replace the battery, with terminal side closest to ZENO GMA
- Using the ½" wrench, connect the internal battery cable to the 12V battery (red wire to red (+) terminal and black wire to black (-) terminal.
- Replace terminal covers
- Check that the display is illuminated
- Close the enclosure

No further checkout is needed.

5.3.2.6 Battery Charger PCA

Tools required: Phillips screwdriver, pliers.

NOTE

If the system is equipped with an EEv enclosure, the battery charger PCA will be located in the EEv enclosure. If buried, excavate the EEv enclosure to access the battery charger PCA.

NOTE

Data will not be collected while replacing the battery charger PCA

- Open the GMA enclosure or EEv enclosure
- Disconnect the battery cable from the ZENO GMA Interface Board
- Remove the cover from the Battery Charger PCA
- Use a Phillips screwdriver to remove the screw and hex nut holding the Battery Charger PCA to the vertical side panel
- Using a Phillips screwdriver and pliers, remove the 4 screws and standoffs holding the Battery Charger PCA to ZENO GMA Interface Board or EEv Interface Board.

CAUTION

Be aware that the ZENO GMA Interface Board has 2 ground planes. The signal ground is on one side of the board and the power ground is on the other side.

- Replace the Battery Charger PCA, seating the Battery Charger PCA onto the ZENO GMA Interface Board or EEv Interface Board
- Replace the 4 standoffs and screws
- Replace the screw and hex nut
- Connect the Internal Battery Cable to the ZENO GMA Interface Board
- Close the enclosure
- No further checkout is needed.

5.3.2.7 Battery Charger PCA Fuse

Tools required: Flat blade screwdriver

NOTE

If the system is equipped with an EEv enclosure, the battery charger PCA will be located in the EEv enclosure. If buried, excavate the EEv enclosure to access the battery charger PCA.

NOTE

Data will not be collected while replacing the battery charger PCA fuse

- Open the GMA enclosure or EEv enclosure
- Disconnect the internal battery cable from the ZENO GMA Interface Board
- Using the flat blade screwdriver, remove the fuse from the fuse holder on the Battery Charger PCA
- Replace the fuse
- Connect the Internal Battery Cable to the ZENO GMA Interface Board
- Check that the display is illuminated
- Close the enclosure
- No further checkout is needed.

5.3.2.8 Battery Cable

Tools required: ½" wrench

NOTE

If the system is equipped with an EEv enclosure, the battery cable will be located in the EEv enclosure. If buried, excavate the EEv enclosure to access the battery cable.

NOTE

Data will not be collected while replacing the battery cable

- Open the GMA enclosure or EEv enclosure
- Remove battery terminal covers
- Using the ½" wrench, disconnect the Internal Battery Cable from the 12V battery
- Disconnect battery cable from the ZENO GMA Interface Board
- Replace the Battery Cable
- Check that the display is illuminated
- Replace battery terminal covers
- Close the enclosure
- No further checkout is needed.

5.3.2.9 GMA Antenna

Tools required: No tools are required to replace the Antenna

NOTE

Data will be collected while replacing the antenna. Data will not be transmitted to the ZENO DCOM

- Remove the antenna from the bottom of the ZENO GMA
- Replace the antenna
- Confirm that data is being received at the ZENO DCOM
- No further checkout is needed.

5.3.2.10 Solar Panel

Tools required: 7/16" socket wrench, voltmeter

NOTE

In some older systems, the solar panel cable is an integral part of the solar panel and must be replaced along with the solar panel.

- Disconnect solar panel cable from solar panel.
- Remove four hex bolts securing the solar panel to the mounting bracket
- Remove the solar panel
- Replace the solar panel
- Measure the output voltage of the solar panel by placing a voltmeter across each solar panel terminal. Under normal daylight conditions, the voltmeter should register approximately 22 volts (or –22 volts).

- Adjust the solar panel to the proper orientation. See setup procedure in section 3.2.
- Tighten the four hex bolts.
- Reconnect the solar panel cable
- No further checkout is needed.

5.3.2.11 Solar Panel Cable

Tools required: No tools are required to replace the Solar Panel Cable

NOTE

In some older systems, the solar panel cable is an integral part of the solar panel and must be replaced along with the solar panel.

NOTE

If solar panel cable is buried, excavate cable before beginning replacement

- Disconnect the Solar Panel Cable from the ZENO GMA
- Disconnect the Solar Panel Cable from the Solar Panel
- Connect the new Solar Panel Cable to the Solar Panel
- Connect the new Solar Panel Cable to the System Enclosure.
- No further checkout is needed.

5.3.2.12 Thermistor Cable

Tools required: See NWS procedures

NOTE

If thermistor cable is buried, excavate cable before beginning replacement

- Disconnect thermistor cable from ZENO GMA
- Following NWS procedures, remove thermistor from thermistor cable
- Following NWS procedures, connect thermistor to new thermistor cable
- Attach thermistor cable to ZENO GMA
- If the thermistor has not been replaced, no further checkout is needed.

5.3.2.13 Shaft Encoder Cable

Tools required: See NWS procedures

NOTE

If shaft encoder cable is buried, excavate cable before beginning replacement

- Disconnect shaft encoder cable from ZENO GMA

- Following NWS procedures, remove shaft encoder from shaft encoder cable
- Following NWS procedures, connect shaft encoder to new shaft encoder cable
- Attach shaft encoder cable to ZENO GMA
- If the shaft encoder has not been replaced, no further checkout is needed.

5.3.2.14 ZENO DCOM

Tools required: No tools are required to replace the ZENO DCOM

- Unplug the AC Power Cord from the AC outlet
- Remove the AC Power Cord from the ZENO DCOM
- Remove the Antenna
- Remove the phone cable from the DCOM Electronics Enclosure
- Replace the ZENO DCOM
- Replace the Antenna with known good antenna.
- Replace the AC Power Cord with known good cord.
- Plug the AC Power Cord into the AC Outlet
- Replace the phone cable with known good cable.
- Check that the ZENO DCOM is illuminated
- Follow setup procedures in section 3.5 to enter other site-specific information
- Using the keypad, enter date and time and any other notations

5.3.2.15 DCOM Antenna

Tools required: No tools are required to replace the DCOM Antenna

NOTE

Data will not be received by the ZENO DCOM while the antenna is being replaced

- Unplug the AC Power Cord from the AC outlet
- Remove the Antenna
- Replace the Antenna
- Plug the AC Power Cord into the AC Outlet
- Check that the ZENO DCOM is displaying data
- No further checkout is needed.

5.3.2.16 DCOM AC Power Cable

Tools required: No tools are required to replace the DCOM AC Power Cable

- Unplug the AC Power Cord from the AC outlet
- Remove the AC Power Cord from the ZENO DCOM
- Replace the AC Power Cord
- Connect the AC power cord
- Plug the AC Power Cord into the AC Outlet
- Check that the DCOM is displaying data
- No further checkout is needed.

5.3.2.17 DCOM Fuse

Tools required: Flat blade screwdriver

- Unplug the AC Power Cord from the AC outlet
- Remove the AC Power Cord from the ZENO DCOM
- Using the flat blade screwdriver, open the fuse holder located at the AC receptacle
- Replace the fuse
- Connect the AC power cord with known good cord.
- Plug the AC Power Cord into the AC Outlet
- Check that the DCOM is displaying data
- No further checkout is needed.

5.3.2.18 EEv Enclosure

Tools required: Phillips screwdriver, pliers

NOTE

If EEv enclosure is buried, excavate EEv enclosure and cables before beginning replacement

- Disconnect the cable leading from the EEv enclosure to the solar panel
- Disconnect the cable leading from the EEv enclosure to the ZENO GMA
- Open the EEv enclosure
- Disconnect the battery cable from the battery charger PCA
- Remove the battery charger PCA
- Remove the battery
- Install the battery charger PCA and battery into the new EEv enclosure

- Connect the battery cable to the battery charger PCA
- Connect the cable to the solar panel
- Connect the cable to the ZENO GMA
- Confirm that the ZENO GMA display is illuminated
- No further checkout is needed.

5.3.2.19 Jumper PCB

Jumper PCB remove and replace procedures are the same as for the battery charger PCA. See Section 5.3.2.6.

5.3.3 Data Recovery

If the ZENO GMA or ZENO DCOM have been replaced, the data may still be accessible. Connect a laptop computer to the maintenance port on the removed unit. If you are able to communicate with the ZENO, the data may be accessible. Follow the data retrieval procedures of section 4.1 or 4.2 to retrieve any stored data.

5.4 REMOTE MAINTENANCE

The GMA enclosure has an external maintenance port for direct communication with the data logger via a laptop. This is a standard RS-232 interface with full duplex communication. Baud rate is selectable between 300 and 19,200 defaulted to 9600. This port is selectable for baud rate, stop and start bits (number of), data bits, parity and handshaking.

When an operator logs into the ZENO®-3200 through the maintenance port or dials in remotely via the DCOM additional functionality is available. The operator can test the correct functioning of the system *without* interrupting its normal operation. The following troubleshooting and maintenance functions are available through the standard 9-pin RS-232 maintenance port or through the dial in DCOM.

- The ZENO® will prompt the operator for a user name and password. No further access will be available without user authentication.
- The user can view the data values being output to the DCOM. See Section 4.2 for access to DCOM data.
- For analog and frequency sensors, the user can observe both raw sensor readings (voltage or frequency), and scaled sensor readings (in engineering units), as they are measured by the ZENO®. This can be done *without* interrupting the normal operation of the system – including transmission of data to the Base Station. At the user menu, type ‘t’ to enter test menu. Type “r1.1” to view precipitation sensor data
- The user can re-boot the ZENO®-3200 without cycling power. Rebooting will interrupt datalogging for the time of reset. At the user menu, type “z” to enter program menu. Type “r” to reset system.

All of these functions are carried out using the ZENO® user-friendly, help-assisted menu system. For example Table 5-1 illustrates the Test Menu.

Table 5-1. Test menu available in the ZENO®

TEST MENU	
(Rx,y) Display Sensors x-y RAW Data	(P) SDI-12 Pass-Through Mode
(Sx,y) Display Sensors x-y SCALED Data	(U) User Menu
(Cx)Calibrate Sensor Record x	(Q) Quit
(Vx) View Process Record x	(H) Help
To look at the scaled data for each sensor, the operator simply types R. More details of all available commands are obtained by typing H.	

6. PARTS LIST

Coastal Environmental Systems

FP Upgrade Technical Manual

Table 6-1. Identification of LRU

Description	Coastal Part Number	ASN
GMA		
Enclosure, GMA	1220124011	
Hardware, GMA Mounting	1220124012	
Assy, ZENO GMA, no radio	1220124013	
Assy, GMA Battery Charger	1220124005	
Fuse, 5A	4301000005	
Assy, ZENO GMA, radio	1220124014	
Assy, GMA Battery Charger	1220124005	
Fuse, 5A	4301000005	
Antenna, Omnidirectional, 2.4GHz, 4DBI	1914000070	
Data Key	2009000004	
Battery, GMA	3903000030	
Cable, Battery	6003124007	
Solar Panel, 20W	3701000036	
Cable, GMA Solar Panel	6003124006	
Bracket, Mounting, Solar Panel	3710000037	
Cable, Thermistor	6003124003	
Assy, GMA Load Cell	1220124010	
Cable, Load Cell	6003124004	
DCOM		
ZENO DCOM	1201124007	
Fuse, 0.75A	4307000006	
Cord, AC Power	6016000015	
Antenna, Omnidirectional, 2.4GHz, 4DBI	1914000070	
EEV		
Assy, EEV Enclosure	1220124008	
PCB, Jumper	1716124009	
MISCELLANEOUS		
Antenna, Directional, YAGI, 2.4GHz, 8DBI	1914000071	
Antenna, Omnidirectional, 2.4GHz, 6DB	1914000077	
Cable, Antenna	6003124013	
Battery Charger, AC	1220124002	
Cord, AC Power	6016000015	
Key Reader	1201124006	